MINI

WORKSHOP MANUAL

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INTRODUCTION

This Manual has been prepared to provide service operators with the necessary information for the correct maintenance and repair of the Mini and Mini-Cooper. The Manual also serves as a ready-reference book for service supervision and covers items of procedure for guidance of both the fully qualified and the less-experienced mechanic.

The early pages contain general data, relating to these cars.

The main body of the publication deals with dismantling, repair, and reassembly, and is grouped into Sections. The pages and illustrations are numbered consecutively within each Section, and the Section title and letter are shown at the top of each page.

Where a Section has a double letter at the top of the page, this Section refers specifically to the Mini-Cooper, but must be used in conjunction with the corresponding single-letter Section.

Where a Section has a treble letter at the top of the page, this Section refers specifically to the Mini-Cooper 'S' but must be used in conjunction with the corresponding double- and single-letter Sections.

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GENERAL DATA

ENGINE

Type	8 MB.
Number of cylinders	4.
Bore	2·478 in. (62·94 mm.).
Stroke	2·687 in. (68·26 mm.).
Capacity	51·7 cu. in. (848 c.c.).
Firing order	1, 3, 4, 2.
Compression ratio	8·3 : 1.
Capacity of combustion chamber (valves fitted)	1·49 cu. in. (24·5 c.c.).
Valve operation	Overhead by push-rod.
B.M.E.P.	128 lb./sq. in. (9 kg./cm.²) at 2,900 r.p.m.
Torque	44 lb. ft. (6·08 kg. m.) at 2,900 r.p.m.
Oversize bore : 1st	+·010 in. (·254 mm.).
Max.	+·040 in. (1·016 mm.).

CRANKSHAFT

Main journal diameter	1·7505 to 1·751 in. (44·46 to 44·47 mm.).
Minimum regrind diameter	1·7105 in. (43·45 mm.).
Crankpin journal diameter	1·6254 to 1·6259 in. (41·28 to 41·29 mm.).
Crankpin minimum regrind diameter	1·5854 in. (40·27 mm.).
Main bearings	
Number and type	3 shell type.
Material	Steel-backed white metal.
Length	1·187 in. (30·16 mm.).
End-clearance	·002 to ·003 in. (·051 to ·076 mm.).
End-thrust	Taken on centre main bearing.
Running clearance	·0005 to ·002 in. (·013 to ·051 mm.).

CONNECTING RODS

Length between centres	5·75 in. (14·605 cm.).
Big-end bearings	
Material	Steel-backed lead-bronze with lead-indium-plated surface, or steel-backed copper-lead with lead-tin-plated surface.
Bearing side-clearance	·008 to ·012 in. (·203 to ·305 mm.).
Bearing diametrical clearance	·001 to ·0025 in. (·025 to ·063 mm.).

PISTONS

Type	Split skirt.
Clearances: Bottom of skirt	·0006 to ·0012 in. (·015 to ·030 mm.).
Top of skirt	·0026 to ·0032 in. (·066 to ·081 mm.).
Oversizes	+·010 in., +·020 in., +·030 in., +·040 in. (·254 mm., ·508 mm., ·762 mm., 1·016 mm.).

PISTON RINGS

Compression: Plain	Top ring.
Tapered	Second and third rings.
Width	·069 to ·070 in. (1·75 to 1·78 mm.).
Thickness	·095 to ·101 in. (2·41 to 2·56 mm.).
Fitted gap	·007 to ·012 in. (·178 to ·305 mm.).
Clearance in groove	·0015 to ·0035 in. (·038 to ·089 mm.).
Oil control type	Slotted scraper.
Width	·124 to ·125 in. (3·15 to 3·175 mm.).
Thickness	·095 to ·101 in. (2·41 to 2·56 mm.).
Fitted gap	·007 to ·012 in. (·178 to ·305 mm.).
Clearance in groove	·0015 to ·0035 in. (·038 to ·089 mm.).

GUDGEON PIN

Type	Clamped in little-end.
Fit in piston	Hand push-fit.
Diameter (outer)	·624 in. (15·86 mm.).

VALVES AND VALVE GEAR

Valves

Seat angle: Inlet	45°.
Exhaust	45°.
Head diameter: Inlet	1·093 to 1·098 in. (27·76 to 27·89 mm.).
Exhaust	1·000 to 1·005 in. (25·40 to 25·53 mm.).
Stem diameter: Inlet	·2793 to ·2798 in. (7·096 to 7·109 mm.).
Exhaust	·2788 to ·2793 in. (7·081 to 7·096 mm.).
Valve lift	·285 in. (7·24 mm.).
Valve stem to guide clearance: Inlet	·0015 to ·0025 in. (·038 to ·064 mm.).
Exhaust	·002 to ·003 in. (·051 to ·076 mm.).
Valve rocker clearance: Running	·012 in. (·305 mm.) (cold).
Timing	·019 in. (·48 mm.).
Timing markings	Dimples on timing wheels, marks on flywheel.
Chain pitch and number of pitches	$\frac{3}{8}$ in. (9·525 mm.). 52.
Inlet valve: Opens	5° B.T.D.C.
Closes	45° A.B.D.C.
Exhaust valve: Opens	40° B.B.D.C.
Closes	10° A.T.D.C.
Valve rocker bush bore (reamed)	·5630 to ·5635 in. (14·30 to 14·312 mm.).

VALVE GUIDES

Length: Inlet and exhaust	1·687 in. (42·86 mm.).
Diameter: Outside: Inlet and exhaust	·469 in. (11·91 mm.).
Inside: Inlet and exhaust	·2813 to ·2818 in. (7·145 to 7·257 mm.).

VALVE SPRINGS

Free length: Inlet and exhaust	1·625 in. (41·27 mm.).
Number of working coils	$4\frac{1}{2}$.
Pressure: Inlet and exhaust: Valve open	70 lb. (31·8 kg.).
Valve closed	37·5 lb. (17·027 kg.).

TAPPETS

Type	Barrel type.
Diameter	·812 in. (20·64 mm.).
Length	1·5 in. (38·10 mm.).

CAMSHAFT

Journal diameters: Front	1·6655 to 1·666 in. (42·304 to 42·316 mm.).
Centre	1·62275 to 1·62325 in. (41·218 to 41·231 mm.).
Rear	1·3725 to 1·3735 in. (34·862 to 34·887 mm.).
End-float	·003 to ·007 in. (·076 to ·178 mm.).
Bearings: Type: Front	White-metal-lined, steel-backed.
Centre and rear	Plain (running in block).
Inside diameter (reamed in position)	1·667 to 1·6675 in. (42·342 to 32·355 mm.).
Clearance: Front	·001 to ·002 in. (·025 to ·051 mm.).
Centre and rear	·00125 to ·00275 in. (·0317 to ·0698 mm.).

ENGINE LUBRICATION SYSTEM

Oil pump

Type	Hobourn Eaton or Burman.
Relief pressure valve opens	60 lb./sq. in. (4·2 kg./cm.^{2}).

Relief valve spring: Free length	$2\frac{55}{64}$ in. (72·63 mm.).
Fitted length	$2\frac{5}{32}$ in. (54·77 mm.).
Oil filter	
Type	Full-flow.
Capacity	1 pint (1·2 U.S. pints, ·57 litre).
Oil pressure	
Normal running	60 lb./sq. in. (4·22 kg./cm.²).
Idling (minimum)	15 lb./sq. in. (1·05 kg./cm.²).

TORQUE WRENCH SETTINGS

Cylinder head stud nuts	40 lb. ft. (5·5 kg. m.).
Connecting rod big-end bolts	35 lb. ft. (4·8 kg. m.).
Main bearing set screws	60 lb. ft. (8·3 kg. m.).
Flywheel centre-bolt	110 to 115 lb. ft. (15·2 to 15·9 kg. m.).
Gudgeon pin clamp screws	25 lb. ft. (3·4 kg. m.).
Rocker shaft bracket nuts	25 lb. ft. (3·4 kg. m.).
Transmission case to crankcase	6 lb. ft. (·8 kg. m.).
Cylinder side cover	2 lb. ft. (·28 kg. m.).
Timing cover—$\frac{1}{4}$ in. UNF. bolts	6 lb. ft. (·8 kg. m.).
Timing cover—$\frac{5}{16}$ in. UNF. bolts	14 lb. ft. (1·9 kg. m.).
Water pump	17 lb. ft. (2·3 kg. m.).
Water outlet elbow	8 lb. ft. (1·1 kg. m.).
Oil filter	16 lb. ft. (2·2 kg. m.).
Oil pump	9 lb. ft. (1·2 kg. m.).
Manifold to cylinder head	15 lb. ft. (2·1 kg. m.).
Rocker cover	4 lb. ft. (·56 kg. m.).
Crankshaft pulley nut	70 lb. ft. (9·6 kg. m.).
Transmission case studs—$\frac{3}{8}$ in. dia. UNC.	8 lb. ft. (1·1 kg. m.).
Transmission case studs—$\frac{5}{16}$ in. dia. UNC.	6 lb. ft. (·8 kg. m.).
Transmission case stud nuts—$\frac{3}{8}$ in. UNF.	25 lb. ft. (3·45 kg. m.).
Transmission case stud nuts—$\frac{5}{16}$ in. UNF.	18 lb. ft. (2·5 kg. m.).
Bottom cover set screws—$\frac{1}{4}$ in. dia. UNC. (change speed tower)	6 lb. ft. (·8 kg. m.).
First motion shaft nut	150 lb. ft. (20·7 kg. m.).
Third motion shaft nut	150 lb. ft. (20·7 kg. m.).
Flywheel housing bolts and stud nuts	18 lb. ft. (2·5 kg. m.).
Set screw, driving strap to flywheel	16 lb. ft. (2·2 kg. m.).
Set screw, clutch spring housing to pressure plate	16 lb. ft. (2·2 kg. m.).
Distributor clamp bolt: Fixed nut type	50 lb. in. (·576 kg. m.).
Fixed bolt type	30 lb. in. (·345 kg. m.).
Final drive	
Driven gear to differential cage	60 lb. ft. (8·3 kg. m.).
Nut, driving flange to differential	80 to 85 lb. ft. (11·06 to 11·75 kg. m.) (and align to next split pin hole).
End cover bolts (differential housing)	18 lb. ft. (2·5 kg. m.).
Suspension and steering	
Steering lever to hub bolts	35 lb. ft. (4·8 kg. m.).
Steering lever ball joint nut	20 to 24 lb. ft. (2·77 to 3·32 kg. m.).
Steering knuckle ball pin bottom nut	35 to 40 lb. ft. (4·8 to 5·5 kg. m.).
Steering knuckle ball pin top nut	35 to 40 lb. ft. (4·8 to 5·5 kg. m.).
Steering knuckle ball pin housing	70 lb. ft. (9·6 kg. m.).
Front hub nut (drive shaft)	60 lb. ft. (8·3 kg. m.).
Rear suspension stub axle nut	60 lb. ft. (8·3 kg. m.) (align to next slot).
Front suspension upper arm pivot pin nut	26 to 28 lb. ft. (3·6 to 3·87 kg. m.).
Steering-wheel nut	41 lb. ft. (5·76 kg. m.).
Road wheel nuts	38 to 43 lb. ft. (5·25 to 5·94 kg. m.).

FUEL SYSTEM

Carburetter

Make and type	S.U. Type HS2.
Diameter	$1\frac{1}{4}$ in. (31·75 mm.).

Jet	·090 in. (2·29 mm.).
Needle	Standard EB. Rich M. Weak GG.

AIR CLEANER

Type	Paper element.

FUEL PUMP

Make and type: Early cars	S.U. electric. PD.
Later cars	S.U. electric. SP.
Delivery rate: PD type	45 pints/hr. (25·5 litres/hr.).
SP and AUF 201 type	56 pints/hr. (32 litres/hr.).
Delivery pressure: PD type	2 to 3 lb./sq. in. (·14 to ·21 kg./cm.²).
SP and AUF 201 type	2½ to 3 lb./sq. in. (·17 to ·21 kg./cm.²).

COOLING SYSTEM

Type	Pressurized radiator, thermo-siphon, pump- and fan-assisted.
Thermostat setting	82° C. (180° F.).
Cold climates	88° C. (188° F.).
Hot climates	74° C. (165° F.).

IGNITION SYSTEM

Sparking plugs	Champion N5.
Size	14 mm.
Plug gap	·025 in. (·625 mm.).
Coil	LA12.
Distributor: Early type	DM2.
Later type	25D4.
Distributor contact points gap	·014 to ·016 in. (·36 to ·40 mm.).

Distributor test data:

	Premium fuel distributor	*Regular (commercial) fuel distributor*
Automatic advance commences at	600 r.p.m. (engine).	1,250 r.p.m. (engine).
Maximum advance	30–34° at 3,400 r.p.m.	22–26° at 5,000 r.p.m.
Vacuum advance	10° at 13 in. (330·2 mm.) Hg.	16° at 11 in. (279·4 mm.) Hg.
Static ignition timing	T.D.C.	7° B.T.D.C.

CLUTCH

BMC single dry plate

Diameter	7·125 in. (180·9 mm.).
Facing material	Wound yarn.
Pressure springs	6.
Colour	Red spot.
Damper springs	Nil.

Diaphragm spring clutch

Make	Borg and Beck.
Diameter	7⅛ in. (18 cm.).
Facing material	Wound yarn.
Damper springs	Nil.
Diaphragm spring colour code	Brown.

GEARBOX

Number of forward speeds	4.
Synchromesh	Second, third, and fourth gears.
Ratios: Top	1·0 : 1.
Third	1·412 : 1.
Second	2·172 : 1.

First	3·627 : 1.
Reverse	3·627 : 1.
Overall ratios: Top	3·765 : 1.
Third	5·317 : 1.
Second	8·176 : 1.
First	13·657 : 1.
Reverse	13·657 : 1.
Speedometer	6/17.

STEERING

Type	Rack and pinion.
Steering-wheel turns—lock to lock	2⅓.
Steering-wheel diameter	15¾ in. (40 cm.).
Camber angle	1° positive to 3° positive.
Castor angle	3°.
King pin (swivel hub) inclination	9° 30′.
Toe-out	1/16 in. (1·6 mm.).
Lock angle of outer front wheel with inner wheel at 20°	18½°.

With vehicle in an unladen condition.

FRONT SUSPENSION

Early models, 1959–1964	Rubber cone spring.
Front	Levers of unequal length.
Rear	Trailing radius arms.
Later models	Hydrolastic displacers.
Front	Levers of unequal length.
Rear	Trailing arms.
Fluid capacity	4 pints (5 U.S. pints, 2·27 litres).
Fluid pressure (unladen)	263 lb./sq. in. (18·49 kg./cm.²).

REAR SUSPENSION

Type	Rubber cone spring.
Toe-in	⅛ in. (3·18 mm.).
Camber	1° positive.
Radius arm bushes (reamed bore)	·8125 to ·8130 in. (20·63 to 20·65 mm.).

HYDRAULIC DAMPERS

Type: Front and rear	Tubular telescopic.

DRIVE SHAFTS

Type	Solid shaft, reverse spline.
Make and type of joint	Hardy Spicer, hemispherical joint.

DIFFERENTIAL

Ratio	3·765 : 1.

ELECTRICAL EQUIPMENT

System	12-volt, positive earth.
Charging system	Compensated voltage control.
Battery	Lucas BLT7A, BLTZ7A, BT7A, BTZ7A.
Capacity: BLT7A, BLTZ7A	34 amp.-hr. at 20-hr. rate.
BT7A, BTZ7A	43 amp.-hr. at 20-hr. rate.
Starter motor	Lucas M35G.
Dynamo	Lucas C40.
Control box	Lucas RB106/2.
Cut-out: Cut-in voltage	12·7 to 13·3.
Drop-off voltage	8·5 to 11·0.
Reverse current	5·0 amps. (max.).

Regulator (at 3,000 r.p.m. dynamo speed):

Open-circuit setting at 20° C. (68° F.)	16·0 to 16·6 volts.

For ambient temperatures other than 20° C. (68° F.) the following allowances should be made to the above setting:

For every 10° C. (18° F.) above 20° C. (68° F.) subtract ·1 volt.

For every 10° C. (18° F.) below 20° C. (68° F.) add ·1 volt.

BRAKES

Lockheed hydraulic	Single-leading-shoe.
Drum size	7 in. (17·8 cm.) diameter.
Lining dimensions: Front or rear	6·75 in. × 1·25 in. (17·14 cm. × 3·17 cm.).
Lining area: Front or rear	33·75 sq. in. (217·7 cm.²).
Lining material	Don 202.
Lockheed hydraulic	Two-leading-shoe.
Lining dimensions	6·75 × 1·5 in. (17·4 × 3·18 cm.).
Lining area total	40·5 sq. in. (261·29 cm.²).
Lining material	Don 202.

WHEELS

Type: Ventilated disc	3·50B × 10.

TYRES

Size	
Standard	5·20—10 tubeless.
Optional (Radial ply)	145—10 tubeless.
Pressures:	
Standard—normal conditions	Front 24 lb./sq. in. (1·7 kg./cm.²).
	Rear 22 lb./sq. in. (1·55 kg./cm.²).
fully loaded	Front and rear 24 lb./sq. in. (1·7 kg./cm.²).
Optional (Radial ply), all conditions:	Front 28 lb./sq. in. (1·97 kg./cm.²).
	Rear 26 lb./sq. in. (1·83 kg./cm.²).

CAPACITIES

Transmission casing (including filter)	8½ pints (10·2 U.S. pints, 4·83 litres).
Cooling system	5¼ pints (6·3 U.S. pints, 3 litres).
With heater	6¼ pints (7·5 U.S. pints, 3·55 litres).
Fuel tank: Saloon	5½ gallons (6·6 U.S. gallons, 25 litres).
Van and Pick-up	6 gallons (7·2 U.S. gallons, 27·3 litres).
Traveller and Countryman: Early models	6½ gallons (7·8 U.S. gallons, 29·6 litres).
Later models with underfloor tank	6 gallons (7·2 U.S. gallons, 27·3 litres).

GENERAL DIMENSIONS

Wheelbase: Saloon	6 ft. 8$\frac{5}{32}$ in. (2·036 m.).
Van, Pick-up, Traveller, and Countryman	7 ft. 0$\frac{5}{32}$ in. (2·138 m.).
Moke	6 ft. 8$\frac{5}{32}$ in. (2·036 m.).
Overall length: Saloon	10 ft. 0¼ in. (3·05 m.).
Van, Traveller, and Countryman	10 ft. 9⅞ in. (3·259 m.).
Pick-up	10 ft. 10½ in. (3·315 m.).
Moke	10 ft. 0 in. (3·04 m.).
Overall width	4 ft. 7½ in. (1·41 m.).
Moke	4 ft. 3½ in. (1·36 m.).
Overall height: Saloon	4 ft. 5 in. (1·35 m.).
Van	4 ft. 6½ in. (1·38 m.).
Traveller, Countryman, and Pick-up	4 ft. 5½ in. (1·36 m.).
Moke	4 ft. 8 in. (1·42 m.).
Ground clearance	6$\frac{5}{32}$ in. (15·63 cm.).
Moke	6½ in. (16·2 cm.).
Turning circle: Saloon	31 ft. 7 in. (9·63 m.).
Van, Pick-up, Traveller, and Countryman	32 ft. 9 in. (9·893 m.).
Moke	31 ft. (9·4 m.).
Track: Front	47$\frac{7}{16}$ in. (1·205 m.).
Rear	45⅞ in. (1·164 m.).
Kerbside weight: Saloon	1,294 lb. (587 kg.).
Van	1,334 lb. (605 kg.) approx.
Traveller and Countryman	1,456 lb. (660 kg.) approx.
Pick-up	1,328 lb. (603 kg.) approx.
Moke	1,240 lb. (562 kg.).

Maximum permissible towing weight (suitable for 1 in 8 gradient in bottom gear):

Saloon	8 cwt. (406·4 kg.).
Van, Pick-up, Traveller, and Countryman	5 cwt. (254·2 kg.).

WEIGHT OF COMPONENTS

Engine and transmission assembly	333 lb. (151 kg.).

GENERAL DATA
(MINI-COOPER)

The following information is applicable to the Mini-Cooper and should be used in conjunction with the preceding specification for the Mini Saloon.

ENGINE

Type	9F.
Number of cylinders	4.
Bore	2·458 in. (62·43 mm.).
Stroke	3·20 in. (81·28 mm.).
Capacity	60·87 cu. in. (997 c.c.).
Compression ratio: High compression	9 : 1.
Low compression	8·3 : 1.
B.M.E.P.: High compression	134 lb./sq. in. (9·42 kg./cm.²) at 3,500 r.p.m.
Low compression	129 lb./sq. in. (9·07 kg./cm.²) at 3,500 r.p.m.
Torque: High compression	54 lb. ft. (7·46 kg. m.) at 3,600 r.p.m.
Low compression	53 lb. ft. (7·32 kg. m.) at 3,500 r.p.m.

CRANKSHAFT

Main bearings

Material	Steel-backed copper-lead; thin wall.
Length	1·0625 in. (26·99 mm.).
Running clearance	·001 to ·0027 in. (·025 to ·069 mm.).

CONNECTING RODS

Big-end bearings

Material	Steel-backed copper-lead; thin wall.
Bearing length	·875 in. (22·22 mm.).

PISTONS

Type	Solid skirt.
Clearance: Bottom of skirt (pressure face)	·0016 to ·0022 in. (·041 to ·056 mm.).

PISTON RINGS

Compression: Top	Plain, chrome-faced.
Second and third	Tapered.
Width	·0615 to ·0625 in. (1·563 to 1·588 mm.).

VALVES AND VALVE GEAR

Valves

Head diameter: Inlet	1·156 in. (29·4 mm.).	
Exhaust	1·000 in. (25·40 mm.).	
Throat diameter: Inlet	1·0312 in. (26·2 mm.).	
Exhaust	·908 in. (23·06 mm.).	
Valve lift	·312 in. (7·92 mm.).	
Inlet valve: Opens	16° B.T.D.C.	With ·019 in. (·48 mm.) valve rocker clearance (for checking purposes only).
Closes	56° A.B.D.C.	
Exhaust valve: Opens	51° B.B.D.C.	
Closes	21° A.T.D.C.	

VALVE SPRINGS

Free length: Inlet and exhaust	1·750 in. (44·45 mm.).
Number of working coils	4½.
Pressure: Inlet and exhaust: Valve open	90 lb. (40·8 kg.).
Valve closed	55 lb. (24·9 kg.).

CAMSHAFT

Journal diameters: Front	1·6655 to 1·666 in. (42·304 to 42·316 mm.).
Centre	1·62275 to 1·62325 in. (41·218 to 41·231 mm.).
Rear	1·3725 to 1·3735 in. (34·862 to 34·887 mm.).
End-float	·003 to ·007 in. (·076 to ·178 mm.).
Bearings: Number and type	3. Steel-backed white metal.
Inside diameter (reamed in position): Front	1·667 to 1·6675 in. (42·342 to 42·355 mm.).
Centre	1·6245 to 1·6255 in. (41·261 to 41·287 mm.).
Rear	1·3748 to 1·3755 in. (34·914 to 34·937 mm.).

ENGINE LUBRICATION SYSTEM

Oil pump

Type	Hobourn Eaton.
Relief pressure valve operates	70 lb./sq. in. (4·92 kg./cm.²).
Relief valve spring: Free length	2 $\frac{39}{64}$ in. (66·28 mm.).
Fitted length	2 $\frac{5}{32}$ in. (54·77 mm.).

Oil pressure

Normal running	70 lb./sq. in. (4·92 kg./cm.²).
Idling (minimum)	15 lb./sq. in. (1·05 kg./cm.²).

FUEL SYSTEM

Carburetters

Make and type	Twin S.U. Type HS2.
Diameter	1 $\frac{1}{4}$ in. (31·75 mm.).
Jet	·090 in. (2·29 mm.).
Needle	Standard GZ.

Fuel pump

Make and type	S.U. electric. Type SP.
Delivery rate	56 pts./hr. (67·2 U.S. pts./hr., 32 litres/hr.).
Delivery pressure	2 $\frac{1}{2}$ to 3 lb./sq. in. (·18 to ·21 kg./cm.²).

AIR CLEANERS

Type	Oil-wetted gauze.

COOLING SYSTEM

Thermostat setting	83° C. (180° F.).

IGNITION SYSTEM

Coil	HA12.
Timing: High compression	7° B.T.D.C. (Premium fuel).
Low compression	5° B.T.D.C. (91 to 96 octane rating fuel, Research Method).

CLUTCH

Pressure springs—colour	Black enamel with white spot.
Diaphragm spring colour code	Light green.

GEARBOX

Ratios: Top	1·0 : 1.	
Third	1·357 : 1.	
Second	1·916 : 1.	
First	3·2 : 1.	
Reverse	3·2 : 1.	
	Standard	*Available alternative*
Overall ratios: Top	3·765 : 1.	3·444 : 1.
Third	5·11 : 1.	4·674 : 1.
Second	7·213 : 1.	6·598 : 1.
First	12·05 : 1.	11·03 : 1.
Reverse	12·05 : 1.	11·03 : 1.

DIFFERENTIAL

Ratio	3·765 : 1 standard; 3·444 : 1 optional (available from BMC Service only).

BRAKES

Front

Type	Disc.
Disc diameter	7 in. (177·8 mm.).
Pad material	DA3.

Rear

Lining material	Don 202.

TORQUE TIGHTENING FIGURES

Calliper retaining bolts	35 to 40 lb. ft. (4·84 to 5·53 kg. m.).
Steering lever ball joint	25 to 30 lb. ft. (3·46 to 4·15 kg. m.).

GENERAL DIMENSIONS

Unladen weight (fully equipped with oil and water, but without fuel)	1,400 lb. (635 kg.).

The following information is applicable to the 998-c.c. engine and should be used in conjunction with the preceding specifications.

ENGINE

Type	9FA.
Number of cylinders	4.
Bore	2·543 in. (64·588 mm.).
Stroke	3·00 in. (76·2 mm.).
Capacity	60·96 cu. in. (998 c.c.).
Compression ratio: High	9 : 1.
Low	7·8 : 1.
B.M.E.P.: High compression	142 lb./sq. in. (10 kg./cm.²) at 3,000 r.p.m.
Low compression	135 lb./sq. in. (9·5 kg./cm.²) at 3,000 r.p.m.
Torque: High compression	57 lb. ft. (7·881 kg. m.) at 3,000 r.p.m.
Low compression	56 lb. ft. (7·74 kg. m.) at 2,900 r.p.m.
Oversize bores: 1st	+·010 in. (·254 mm.).
2nd	+·020 in. (·508 mm.).

CRANKSHAFT

Main bearings

Material	Steel-backed copper-lead or aluminium-tin; thin wall.
Running clearance	·001 to ·0027 in. (·025 to ·069 mm.).

CONNECTING RODS

Big-end bearings

Material	Steel-backed copper-lead or aluminium-tin; thin wall.
Bearing length	·875 in. (22·22 mm.).

PISTONS

Type	Solid skirt.
Clearance: Bottom of skirt (pressure face)	·0005 to ·0011 in. (·013 to ·028 mm.).
Oversizes: 1st	+·010 in. (·254 mm.).
2nd	+·020 in. (·508 mm.).

PISTON RINGS

Compression: Top	Plain, chrome-faced.
Second and third	Tapered.
Width	·0620 to ·0625 in. (1·574 to 1·588 mm.).
Thickness (all rings)	·106 to ·112 in. (2·692 to 2·835 mm.).

GUDGEON PIN

Type	Fully floating, with circlip location.
Fit in piston	·0001 in. (·0025 mm.) tight to ·00035 in. (·0089 mm.) slack.
Fit in small end	·0002 in. (·005 mm.) slack, to size.
Diameter	·6244 in. (15·86 mm.) to ·6247 in. (15·867 mm.).

VALVES AND VALVE GEAR

Valves

Throat diameter: Inlet	1·172 in. (29·77 mm.).
Exhaust	·908 in. (23·06 mm.).
Head diameter: Inlet	1·219 in. (30·86 mm.).
Exhaust	1·00 in. (25·4 mm.).
Valve lift	·312 in. (7·92 mm.).
Inlet valve: Opens	5° B.T.D.C.
Closes	45° A.B.D.C.
Exhaust valve: Opens	51° B.B.D.C.
Closes	21° A.T.D.C.

VALVE SPRINGS

Free length: Inner	1·672 in. (42·47 mm.).
Outer	1·75 in. (44·45 mm.).
Pressure: Inner: Valve closed	18 lb. (8·17 kg.).
Valve open	30 lb. (13·6 kg.).
Outer: Valve closed	55½ lb. (25·13 kg.).
Valve open	88 lb. (39·9 kg.).

FUEL SYSTEM

Carburetter

Needle	Standard GY.
Spring	Blue.

IGNITION SYSTEM

Timing: 9·0 : 1 compression ratio	5° B.T.D.C. (Premium fuel).
7·8 : 1 compression ratio	5° B.T.D.C. (91 to 96 octane [Research Method] fuel).
Distributor	Lucas. Type 25D4.

GENERAL DATA
(MINI-COOPER 'S')

The following information is applicable to the Mini-Cooper 'S' and should be used in conjunction with the preceding specifications.

ENGINE

Number of cylinders	4.
Bore (all models)	2·780 in. (70·6 mm.).
Stroke: 970 c.c.	2·4375 in. (61·91 mm.).
1071 c.c.	2·687 in. (68·26 mm.).
1275 c.c.	3·2 in. (81·33 mm.).
Cubic capacity: 970 c.c.	59·1 cu. in. (970 c.c.).
1071 c.c.	63·35 cu. in. (1071 c.c.).
1275 c.c.	77·9 cu. in. (1275 c.c.).
Compression ratio: 970 c.c.	10 : 1.
1071 c.c.	9·0 : 1.
1275 c.c.	9·75 : 1.
Capacity of combustion chamber (valves and sparking plug fitted)	1·306 cu. in. (21·4 c.c.).
B.M.E.P.: 970 c.c.	142 lb./sq. in. (9·98 kg./cm.²) at 4,500 r.p.m.
1071 c.c.	143 lb./sq. in. (10·05 kg./cm.²) at 4,500 r.p.m.
1275 c.c.	153 lb./sq. in. (10·76 kg./cm.²) at 3,000 r.p.m.
Torque: 970 c.c.	57 lb. ft. (7·88 kg. m.) at 5,000 r.p.m.
1071 c.c.	62 lb. ft. (8·58 kg. m.) at 4,500 r.p.m.
1275 c.c.	79 lb. ft. (10·92 kg. m.) at 3,000 r.p.m.
Compression pressure	190 to 200 lb./sq. in. (13·36 to 14·07 kg./cm.²) at 500 r.p.m.
Engine idle speed	650 r.p.m.

CRANKSHAFT

Main journal diameter	2·0005 to 2·0010 in. (50·81 to 50·82 mm.).
Minimum regrind diameter	1·9805 to 1·9810 in. (50·30 to 50·31 mm.).
Main bearings	
Material	Steel-backed copper-lead; thin wall.
Length	1·000 in. (25·4 mm.).
Running clearance	·001 to ·0027 in. (·025 to ·068 mm.).

CONNECTING RODS

Little-end bore diameter	·8110 to ·8115 in. (20·60 to 20·61 mm.).

PISTONS

Type	Solid skirt.
Clearance: Bottom of skirt (pressure face)	·0019 to ·0025 in. (·048 to ·063 mm.).
Top of skirt	·025 to ·0283 in. (·63 to ·72 mm.).

PISTON RINGS

Compression: Plain	Top ring.
Tapered	Second and third ring.
Width	·0459 to ·0469 in. (1·16 to 1·19 mm.).
Thickness	·116 to ·122 in. (29·4 to 30·9 mm.).
Fitting gap	·008 to ·013 in. (·20 to ·33 mm.).
Clearance in groove	·0015 to ·0035 in. (·04 to ·09 mm.).
Oil control type	
Width	·1553 to ·1563 in. (3·94 to 3·96 mm.).
Thickness	·116 to ·122 in. (29·4 to 30·9 mm.).
Fitted gap	·008 to ·013 in. (·20 to ·33 mm.).
Clearance in groove	·0015 to ·0035 in. (·04 to ·09 mm.).

GUDGEON PIN

Type	Pressed in connecting rod.
Fit in piston	Hand push-fit.
Diameter (outer)	·8123 to ·8125 in. (20·63 to 20·64 mm.).
Fit in connecting rod	·0008 to ·0015 in. (·020 to ·038 mm.) interference.

VALVES AND VALVE GEAR

Valves

Head diameter: Inlet	1·401 to 1·406 in. (35·58 to 35·71 mm.).
Exhaust	1·214 to 1·219 in. (30·83 to 30·96 mm.).
Valve lift	·318 in. (8·08 mm.) nominal.
Stem diameter: Exhaust	·2788 to ·2793 in. (7·08 to 7·09 mm.).
Inlet	·2793 to ·2798 in. (7·09 to 7·11 mm.).
Valve rocker clearance: Standard	·012 in. (·30 mm.) cold.
Competition	·015 in. (·38 mm.) cold.
Timing	·021 in. (·53 mm.).
Inlet valve: Opens	5° B.T.D.C.
Closes	45° A.B.D.C.
Exhaust valve: Opens	51° B.B.D.C.
Closes	21° A.T.D.C.

With ·021 in. (·53 mm.) valve rocker clearance (for checking purposes only).

VALVE SPRINGS

Free length: Inner	1·705 in. (43·31 mm.).
Outer	1·740 in. (44·19 mm.).
Number of working coils: Inner	$6\frac{1}{4}$.
Outer	$4\frac{1}{2}$.
Pressure: Inner: Valve closed	26·6 lb. (12·065 kg.).
Valve open	46 lb. (20·865 kg.).
Outer: Valve closed	49·6 lb. (22·498 kg.).
Valve open	94 lb. (42·638 kg.).

CAMSHAFT

Journal diameter: Rear	1·37275 to 1·3735 in. (34·87 to 34·88 mm.).
Inside diameter (reamed in position): Rear	1·3745 to 1·3750 in. (34·91 to 34·92 mm.).
Running clearance: Rear	·001 to ·00225 in. (·025 to ·057 mm.).
Bearing length: Rear	$\frac{49}{64}\pm$·010 in. (19·45±·25 mm.).

ENGINE LUBRICATION SYSTEM

Oil pressure (normal running)	60 lb./sq. in. (4·22 kg./cm.²) at 70° C. (158° F.) oil temperature.

COOLING SYSTEM

Thermostat setting	82° C. (180° F.).

IGNITION SYSTEM

Sparking plugs	Champion N9Y.
Coil	HA12.
Distributor	23D4.
Static ignition timing: 970 c.c.	12° B.T.D.C.
1071 c.c.	3° B.T.D.C.
1275 c.c.	2° B.T.D.C.
Centrifugal advance (crankshaft degrees): 970 c.c.	24° at 1,500 r.p.m., 32° at 4,000 r.p.m.
1071 c.c.	15° at 1,500 r.p.m., 23° at 4,000 r.p.m.
1275 c.c.	14° at 1,500 r.p.m., 22° at 4,000 r.p.m.

FUEL SYSTEM

Carburetter needle: 970 c.c.	AN.
1071 c.c.	H6.
1275 c.c.	M.

CLUTCH

Make and type: Early type	BMC single dry plate.
Later type	Diaphragm spring.
Diameter	7·125 in. (180·9 mm.).
Facing material Standard	Wound yarn, riveted.
Optional	Wound yarn, cemented and riveted.
Pressure springs (early type): Inner	6.
Outer	6.
Colour: Inner	Green spot.
Outer	White spot.

GEARBOX

	Standard	*Optional*
Ratios: Top	1·0 : 1	1·0 : 1
Third	1·357 : 1	1·242 : 1
Second	1·916 : 1	1·78 : 1
First	3·200 : 1	2·57 : 1
Reverse	3·200 : 1	2·57 : 1

Overall gear ratios (as applicable):

Standard gearbox

Final drive ratio	*1st and reverse*	*2nd*	*3rd*	*4th*
3·765	12·05 : 1	7·21 : 1	5·11 : 1	3·765 : 1
3·444	11·02 : 1	6·60 : 1	4·67 : 1	3·444 : 1
3·939	12·06 : 1	7·54 : 1	5·34 : 1	3·939 : 1
4·133	13·27 : 1	7·92 : 1	5·61 : 1	4·133 : 1
4·267	13·65 : 1	8·18 : 1	5·79 : 1	4·267 : 1

Optional gearbox

Final drive ratio	*1st and reverse*	*2nd*	*3rd*	*4th*
3·765	9·66 : 1	6·70 : 1	4·68 : 1	3·765 : 1
3·444	8·84 : 1	6·13 : 1	4·28 : 1	3·444 : 1
3·939	10·12 : 1	7·02 : 1	4·89 : 1	3·939 : 1
4·133	10·61 : 1	7·35 : 1	5·13 : 1	4·133 : 1
4·267	10·90 : 1	7·61 : 1	5·30 : 1	4·267 : 1

Road speed in top at 1,000 r.p.m.

Ratio	
3·765	14·7 m.p.h. (23·52 km.p.h.).
3·444	16·07 m.p.h. (25·71 km.p.h.).
3·939	14·06 m.p.h. (22·5 km.p.h.).
4·133	13·4 m.p.h. (21·44 km.p.h.).
4·267	12·96 m.p.h. (20·74 km.p.h.).

DIFFERENTIAL

Ratio—standard: 970 c.c.	3·765 : 1.
1071 c.c.	3·765 : 1.
1275 c.c.	3·444 : 1.
Alternative ratios	3·939, 4·133 and 4·267 : 1.

BRAKES

Type	Lockheed hydraulic with vacuum servo.
Front	
Type	Disc.
Disc diameter	$7\frac{1}{2}$ in. (190·5 mm.).
Pad material	DA6.
Minimum pad thickness	$\frac{1}{16}$ in. (1·6 mm.).

FRONT HUBS

Bearings	Timkin taper roller.

WHEELS

Type: Ventilated disc	3·50B × 10 or 4·5J × J10.

TYRES

Size: Standard	145—10SP, tubed, or 5·20—10C41 tubed.
Optional	500L—10, tubed.
Tyre pressures (145—10SP and 5·20—10C41 only):	
Front	28 lb./sq. in. (1·969 kg./cm.²).
Rear	26 lb./sq. in. (1·828 kg./cm.²).

TORQUE WRENCH SETTINGS

Cylinder head nuts (10 off)	42 lb. ft. (5·807 kg. m.).
Cylinder head bolt (front, 1 off)	25 lb. ft. (3·456 kg. m.).
Connecting rod big-end bolts	46 lb. ft. (6·221 kg. m.).
Main bearing set screws (early type)	67 lb. ft. (9·263 kg. m.).
Main bearing nuts (later type)	57 lb. ft. (7·88 kg. m.).
Drive shaft nut	150 lb. ft. (20·74 kg. m.).

DIMENSIONS

Track: Front: 3·5 in. rim	$47\frac{17}{32}$ in. (1·207 m.).
4·5 in. rim	$48\frac{17}{32}$ in. (1·233 m.).
Rear: 3·5 in. rim	$46\frac{5}{16}$ in. (1·176 m.).
4·5 in. rim	$47\frac{5}{16}$ in. (1·202 m.).
Weight (unladen)	1,411 lb. (640 kg.) approx.

SECTION A

THE ENGINE

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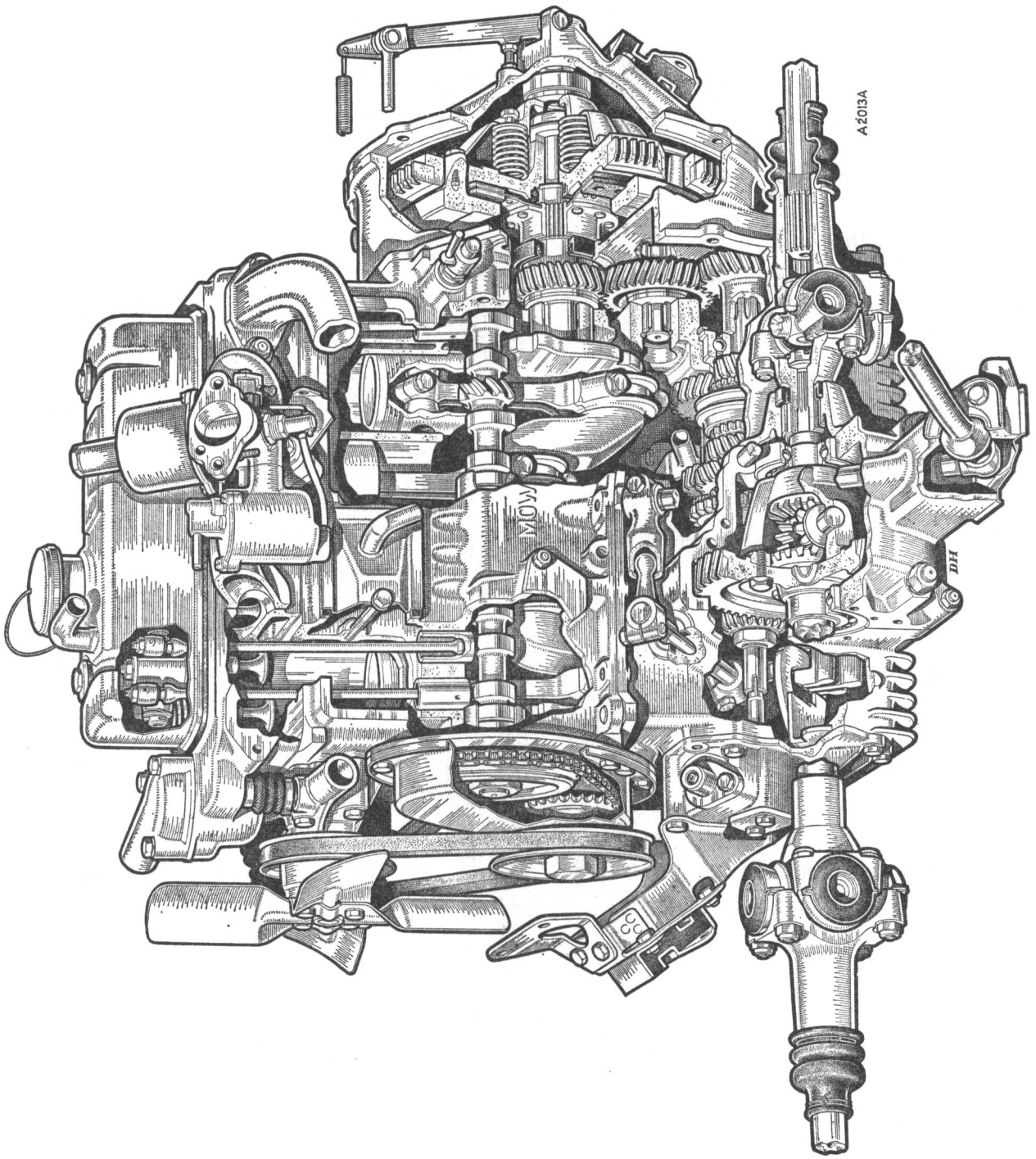
THE POWER UNIT AND TRANSMISSION ASSEMBLY



GENERAL DESCRIPTION

The overhead-valve engine is of unit construction with one reverse and four forward gears, assembled into a combined transmission casing and oil sump below the engine crankcase. The unit is transversely mounted on flexible rubber mountings with the mainshaft in constant mesh with a differential assembly mounted on the side of the transmission casing. Drive is transmitted from the differential by short driving shafts to each of the front wheel hubs.

Engine valves are set in line in the left-hand side of the cylinder head. Oil seals are fitted to the valve stems and there is normal provision on the valve rockers for clearance adjustment.

The camshaft is roller-chain-driven from the crankshaft, with synthetic rubber chain tensioners. At the timing gear end the camshaft has a steel-backed white-metal bearing, the other two journals running direct in the crankcase. Both the oil pump and the distributor are driven from the camshaft, the distributor by a transverse shaft with helical gear drive.

Pistons are of the split-skirt type with two compression rings and one slotted oil control ring. The gudgeon pins are clamped to the connecting rods, which have renewable steel-backed big-end bearings with lead-indium- or lead-tin-plated surfaces.

The oil supply for the engine, gears, and differential is carried in the transmission case below the crankcase and is replenished through a filler aperture in the valve rocker cover.

Oil is drawn from the base of the transmission casing by a rotary pump mounted on the rear end of the crankcase and delivered to a full-flow external oil filter, passing on through drilled passages to the main, big-end, and camshaft bearings. Jet holes in the connecting rods deliver oil quickly to the cylinder walls, and the overhead rocker gear is provided with oil at reduced pressure via the camshaft front bearing.

The tappets are lubricated by oil returning from the rocker gear by way of the push-rod apertures and by splash.

Where vehicles are equipped with an oil pressure warning light in the instrument panel the light is controlled by a hydraulically operated switch fitted at the rear end of the oil gallery. When an oil gauge is fitted a pipe connects the rear end of the oil gallery to the gauge.

The external oil filter carried on the right-hand side of the engine crankcase is of the full-flow, renewable-element type. It is connected to the main oil gallery by a drilled passage.

Section A.1

LUBRICATION

Checking the engine oil level

Inspect the oil level in the engine, and top up if necessary to the 'MAX' or 'FULL' mark on the dipstick. The oil filler cap is on the top of the engine valve cover and is released by turning it anti-clockwise.

Changing the engine oil

Drain the oil from the engine by removing the drain plug on the rear right-hand side of the transmission casing. Draining is preferable when the engine is hot as the oil will flow more readily in this condition; allow at least 10 minutes for draining before replacing the plug. Models fitted with a differential pressure switch on the filter head will give an indication that an oil change is required when a warning light in the instrument panel appears and continues to glow and when the engine is running at or above idling speed. Both the engine oil and the filter element must be changed as soon as possible within a maximum of the next 300 miles (500 km.).

Changing the engine oil filter

Unscrew the central retaining bolt to release the oil filter bowl and element. Clean the filter bowl in fuel and fit the correct replacement element. Ensure that the felt or rubber sealing washer is in good condition and a snug fit to the central retaining bolt. The internal seating must be fitted in the order shown in the illustration (Fig. A.1).

Fit a new filter bowl sealing ring in the filter head location recess. Insert the new element into the bowl and refit the assembly to the filter head, rotate the bowl while tightening the retaining bolt to ensure correct location of the bowl to the filter head. Check for signs of leakage immediately the engine is started.

NOTE.—Disconnect the battery before commencing work on the filter.

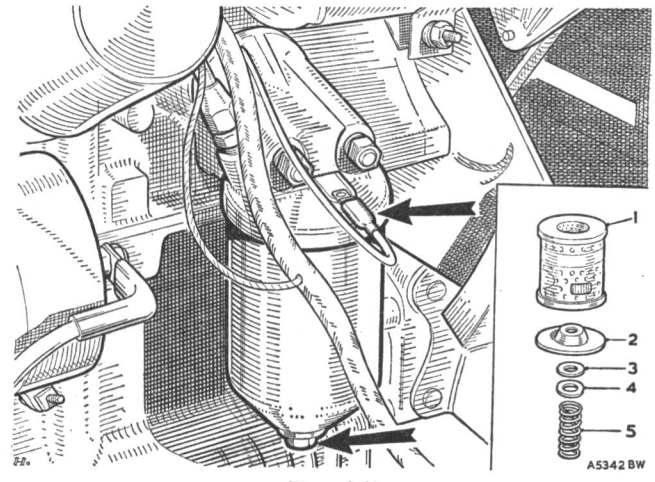


Fig. A.1

The engine oil filter, showing the warning light pressure differential switch and filter retaining bolt

1. Filter element.
2. Seating plate.
3. Seating washer.
4. Steel washer.
5. Spring.

Section A.2

OIL PRESSURE

Should there be a noticeable drop in oil pressure, the following points should be checked:

(1) That there is an adequate supply of the correct grade oil in the transmission casing.

(2) That there is no air leakage at the pump pick-up union on the suction side of the pump and that the oil pump is not worn and is functioning

correctly. See Section A.24 for oil pump removal and dismantling.

(3) That the strainer in the transmission casing is clean and not choked with sludge.

(4) That the bearings to which the oil is fed under pressure have the correct working clearance. Should the bearings be worn and the clearances excessive, the oil will escape more readily from the sides of the bearings, particularly when the oil is warm and becomes more fluid.

The points mentioned can all cause a drop in pressure.

Continuous cold running and the unnecessary use of the mixture control are often the causes of oil dilution by fuel and a consequent fall-off in pressure. Particular attention should be given to oil changes at the recommended periods.

NOTE.—The automatic relief valve in the lubrication system deals with any excessive oil pressure when starting from cold. When hot, the pressure drops as the oil becomes more fluid. Details of the relief valve are given in Section A.3.

Section A.3

OIL PRESSURE RELIEF VALVE

The non-adjustable oil pressure relief valve is situated at the rear right-hand side of the cylinder block and is held in position by a domed hexagon nut and sealed by a folded copper washer. The relief valve spring maintains a valve cup against a seating machined in the cylinder block to provide an extra return passage for the oil should the pressure become excessive.

The valve cup should be examined to ensure that it is seating correctly and that the spring has not lost its tension. The cup can be removed and ground into its seating with Service tool 18G 69 and the spring checked by measuring its length (see **'GENERAL DATA'**). Fit a new cup and spring if necessary.

Section A.4

CARBURETTER AND AIR CLEANER

Removing

Disconnect the breather hose from the rocker cover, remove the air cleaner retaining butterfly nut, and lift off the air cleaner.

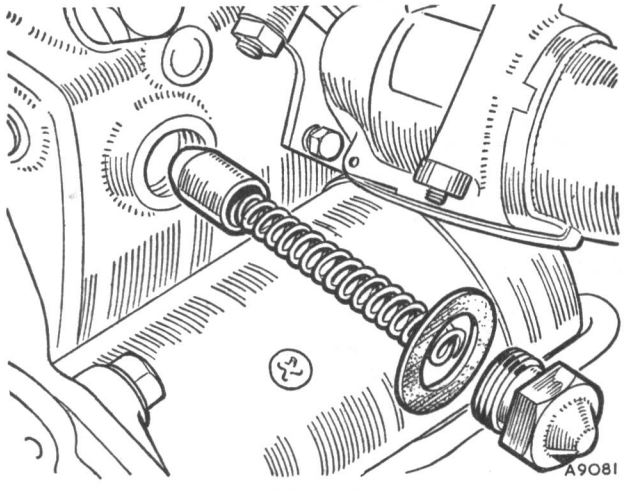


Fig. A.2

The oil pressure relief valve

Disconnect the mixture and throttle control cables, the suction advance pipe, and the fuel delivery hose from their respective positions on the carburetter.

Remove the two nuts and spring washers securing the carburetter to the manifold flange. Lift off the carburetter and the cable abutment plate.

Refitting

It should be noted that the cable abutment plate fitted between the carburetter and manifold flange has a gasket fitted on both faces. Should either gasket be damaged, the plate and the flanges must be thoroughly cleaned and new gaskets fitted.

Section A.5

EXHAUST SYSTEM

Slacken off the exhaust pipe to manifold clamp, and release the pipe from its fixing point (see Fig. A.11) on the gear change extension and from the two locations on the rear sub-frame.

Refitting

To obtain the maximum freedom from engine vibration, and to avoid subjecting the exhaust system to strain, the following refitting procedure must be followed.

Unscrew and withdraw the bolt securing the engine tie-rod to the cylinder block.

Assemble the exhaust system to the car, leaving the pipe to manifold clamp slack enough to permit articulation on the spherical joint and the rear pipe support clips loose enough to allow endwise float of the whole system.

Push the engine forward to line up the hole in the tie-rod with the threaded hole in the cylinder block, and wedge the engine in this position with a suitable wooden block placed between the manifold and the bulkhead. If appreciable force is required to align the two holes, slacken the two bolts securing the engine mounting to the sub-frame to ease alignment, subsequently retightening them. Insert and tighten up the tie-rod bolt.

With the engine still wedged in this position insert sufficient slip packings to fill the gap between the transmission casing lug and the pipe support stay. Insert the bolt and tighten up at this point. If the hole in the lug is threaded, it should be drilled out with a ·316 in. (8 mm.) drill, and a $\frac{5}{16}$ in. UNF. bolt and nut used to replace the set screw.

Tighten up the pipe to manifold clamp, also the pipe and tail pipe support clips. Remove the wedge from between the manifold and the bulkhead.

Section A.6

EXHAUST MANIFOLD

Removing

Remove the carburetter and air cleaner as detailed in Section A.4. Slacken off and release the exhaust pipe

clamp. Remove the six nuts and washers securing the manifold to the cylinder head; withdraw the manifold.

Refitting

Reverse the above order, but thoroughly clean the joint faces and fit a new gasket, placing the perforated metal face of the gasket towards the manifold.

Section A.7

VALVE ROCKERS

Removing

Drain the cooling system; use a clean container for coolant if it contains anti-freeze intended for further use.

Remove the air cleaner as in Section A.4.

Unscrew the two securing screws and lift off the rocker cover, taking care not to damage the cork gasket.

Slacken the eight rocker shaft bracket fixing nuts and the five external cylinder head stud nuts gradually, a turn at a time, in the order shown in Fig. A.4, until all the load is released.

NOTE.—The five external cylinder head fixing nuts must be slackened at the same time as the rocker shaft securing nuts, and in the order given in Fig. A.4, otherwise distortion may take place and result in water finding its way into the cylinder bores and the transmission casing.

Completely unscrew the eight rocker shaft bracket nuts and remove the rocker assembly, together with the brackets.

Withdraw the push-rods, at the same time marking them for replacement in their original positions.

Dismantling

Remove the grub screw locating the rocker shaft in the front rocker mounting bracket. Withdraw the split pins, flat washer, and spring washer from the end of the shaft and slide the rockers, brackets, and springs from the shaft. Remove the screwed plug fitted to one end of the shaft and clean out the oilway.

Reassembly

When reassembling commence with the front mounting bracket, securing it with the grub screw. Follow up with the remaining brackets and springs, replacing them in their original position on the shaft. The screwed plug end of the shaft should be positioned to the front of the engine.

Refitting

Refitting is a reversal of the removal procedure, with special emphasis on the tightening of the rocker bracket and cylinder head stud nuts; these must be tightened in the order shown in Fig. A.4 and to the torque wrench figure given under **'GENERAL DATA'.**

Refer to Section A.15 for details of valve rocker adjustment.

Section A.8

VALVE ROCKER BUSHES

Rebushing of the pressed-steel valve rocker fitted as an alternative to the forged is not practical and must not be undertaken. When bushes become worn new rocker assemblies must be fitted. The forged type of rocker can, however, be rebushed, and the following procedure is given for this type of rocker only.

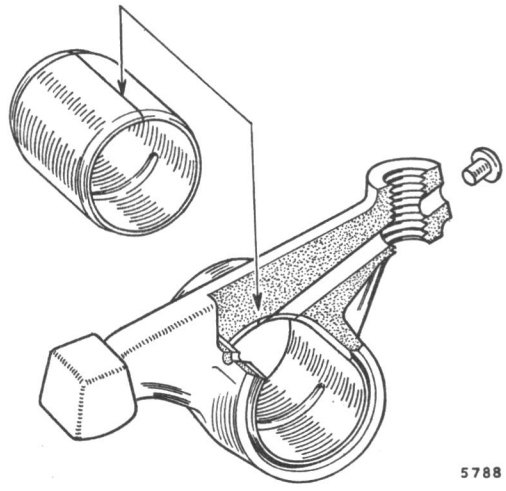


Fig. A.3

When rebushing the forged-type valve rocker make certain that the joint in the bush is in the position indicated

Remove and dismantle the rocker shaft assembly as detailed in Section A.7.

To remove and replace worn bushes the use of special Service tools 18G 226 and 18G 226 A comprising a drift and anvil is recommended. Bushes and rockers are very easily damaged by the use of improvized drifts.

The anvil is recessed to hold the rocker in position while the worn bush is driven or pressed out.

Press the new bush into the rocker bore with the butt joint of the bush positioned at the top of the bore as in Fig. A.3. The drift is recessed to prevent the bush opening when being driven into position.

It will be necessary to drill the oil holes in the bush to coincide with the oilways in the rocker. Should the oil hole to the adjuster end be drilled before the bush is fitted, extra care must be taken to keep the holes in the bush and rocker in line during the pressing-in operation. If the holes are drilled after fitting, the following procedure must be adopted. Remove the adjuster screw and use a No. 43 drill (·089 in. [2·26 mm.]) to drill out the end plug and to continue the oilway through the bush. Replug the end after the operation with a rivet (Part No. 5C 2436) and weld it in position.

The hole in the top of the rocker barrel must be continued through the bush with a No. 47 (·0785 in. [1·98 mm.]) diameter drill. Finally, burnish-ream the bush to the dimensions given under **'GENERAL DATA'.**

Section A.9

CYLINDER HEAD

Removing

Drain the cooling system by means of the drain taps on the radiator bottom tank and at the rear left-hand

side of the cylinder block. If anti-freeze mixture is in use it should be drained into a suitable clean container.

Disconnect the earth cable from the battery. Slacken the retaining clip on the hose connecting the radiator to the thermostat housing and pull the hose clear of the housing.

Remove the three set screws securing the radiator tie-plate to the thermostat housing.

Remove the carburetter and air cleaner as described in Section A.4. Take out the two rocker cover retaining screws and rubber cups and remove the cover.

Detach the high-tension cables and remove the sparking plugs, taking care not to damage the porcelain insulators.

Whenever the head has been disturbed or the valves have been ground in or otherwise disturbed it is necessary to check the valve clearances as in Section A.15. These, of course, will be finally adjusted after the engine has been completely reassembled and run for a short period.

Replace the inlet and exhaust manifold.

If a heater is fitted attach the heater hose to the heater control valve and refit the suction advance pipe to its fixture on the thermostat housing.

Replace the rocker cover, being careful to fit its cork gasket correctly into position and securing it by its nuts, washers, and rubber cups.

Replace the carburetter and air cleaner (as in Section A.4).

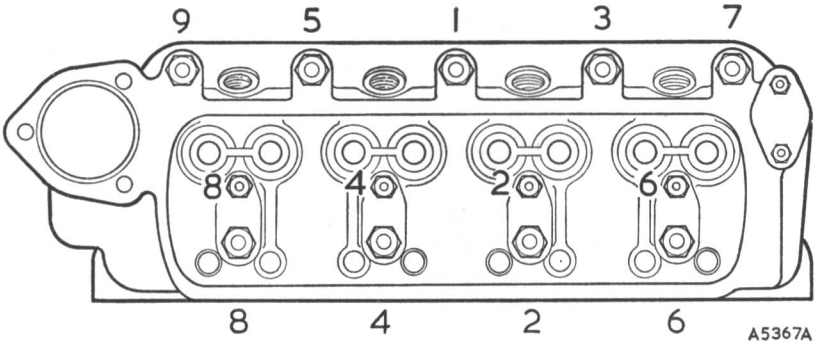


Fig. A.4

The order of slackening and tightening the cylinder head retaining nuts

Remove the suction advance pipe clip from its fixture on the thermostat housing. If the car is fitted with a heater remove the hose from the control valve, which is situated at the rear right-hand top of the cylinder head.

Slacken the top clip on the water by-pass hose.

Remove the inlet and exhaust manifold as described in Section A.6.

Remove the rocker assembly as described in Section A.7, not forgetting to slacken the five external cylinder head holding nuts at the same time. Withdraw the push-rods, keeping them in order of removal.

The cylinder head may now be removed.

NOTE.—To facilitate breaking the cylinder head joint, tap each side of the head with a hammer, using a piece of wood interposed to take the blow. When lifting the head a direct pull should be given so that the head is pulled evenly up the studs.

Refitting

Make sure that the surfaces of both the cylinder block and the cylinder head are clean; it is not necessary to use jointing compound or grease for the gasket. It will be noticed that the cylinder head gasket is marked 'FRONT' and 'TOP' so that it will be replaced correctly. Having slipped the gasket over the studs, lower the cylinder head into position and fit the five cylinder head securing nuts finger tight.

Insert the push-rods, replacing them in the positions from which they were taken. Replace the rocker assembly and securing nuts and fit the nuts finger tight. Tighten all 13 nuts gradually, a turn at a time, in the order given in Fig. A.4.

Secure the radiator tie-plate and reconnect the radiator hose to the thermostat housing.

Connect the negative cable to the battery terminal; close the water drain taps and refill the cooling system.

Check, adjust, and replace the sparking plugs, and clip on the high-tension leads.

Switch on the ignition and check the fuel system for leaks.

Start the engine and run it until the normal working temperature is reached. Remove the rocker cover and check the valve clearances (see Section A.15). Replace the rocker cover.

Refit the bonnet.

Section A.10

DECARBONIZING

Remove the cylinder head as described in Section A.9.

Withdraw the valves as described in Section A.11.

Remove the cylinder head gasket and plug the waterways with a clean rag.

If special equipment is not available for decarbonizing it will be necessary to scrape the carbon deposit from the piston crowns, cylinder block, and cylinder head, using a blunt scraper.

A ring of carbon should be left round the periphery of the piston crown and the rim of carbon round the top of the cylinder bore should not be touched. To facilitate this an old piston ring can be sprung into the bore so that it rests on top of the piston.

The cylinder head is next given attention. The sparking plugs must be cleaned and adjusted. Clean off the carbon deposit from the valve stems, valve ports, and combustion spaces of the cylinder head. Remove all traces of carbon dust with compressed air or by the vigorous use of a tyre pump and then thoroughly clean with paraffin (kerosene) and dry off.

Fit a new cylinder head gasket when replacing the head if the old one has been damaged, noting that the gasket is marked to indicate the top face and the front end.

Section A.11

VALVES

Removing

Remove the cylinder head as detailed in Section A.9.

Before removing the valves stamp the head of each valve with a number to indicate the position to which it must be returned. Commence with No. 1 at the front of the engine.

Remove the cotter clip, compress the valve spring with a special valve spring compressor, and remove the split cotters.

Release the valve spring and remove the compressor. Remove the retaining cap, shroud, valve spring, and rubber seal. Withdraw the valve from the guide.

Keep the valves in their relative positions when removed from the cylinder head to ensure replacement in their original valve guides. The exhaust valve heads are concave and are smaller than the inlet valves.

Refitting

Place each valve in its respective guide and fit the spring, spring shroud, and the retaining cap. Compress the spring and fit a new sealing rubber to the valve stem, push the seal against the bottom shoulder of the cotter

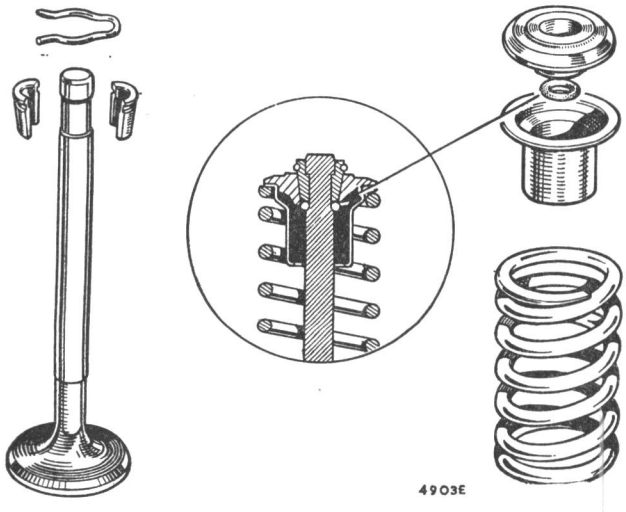


Fig. A.5

The component parts of the valve assembly. The inset shows the valve packing ring fitted correctly at the bottom of the cotter groove below the cotters

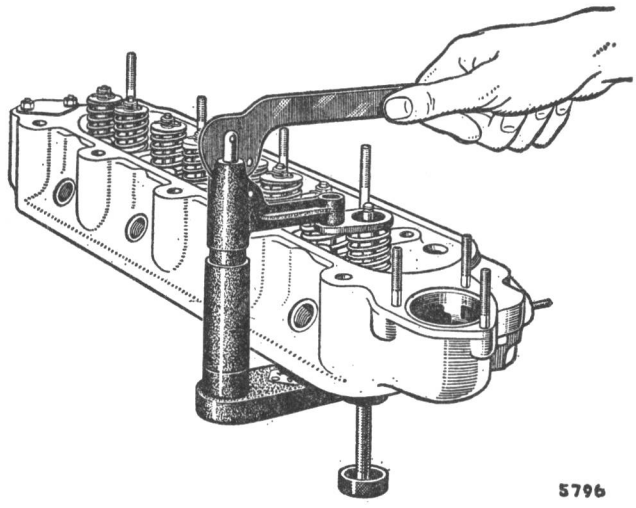


Fig. A.6

Compressing a valve spring, using the special compressing tool 18G 45

recess, and refit the cotters. Ensure that the rubber seal is not pushed out of the cotter recess onto the larger diameter of the stem, release the compressing tool, and fit the split cotter retaining clip.

Section A.12

VALVE-GRINDING

Remove the valves as in Section A.11.

Each valve must be cleaned thoroughly and carefully examined for pitting. Valves in a pitted condition should be refaced with a suitable grinder or new valves should be fitted. Stamp any new valve with the number of the port to which it is fitted.

If the valve seats show signs of pitting or unevenness they should be trued by the use of the special service cutting tools illustrated at the end of Section A. These tools will save lengthy and wasteful grinding in. When using a cutting tool take care to remove only as much metal as necessary to ensure a true surface. Worn valve seats usually have a glass-hard surface, and the glaze breaker illustrated should be used to prepare the valve seat surface for any recutting that may be necessary. Narrowing cutters should be used to maintain the valve seats to the dimension given under **'GENERAL DATA'.**

When grinding a valve onto its seating the valve face should be smeared lightly with fine- or medium-grade carborundum paste and then lapped in with a suction grinder. Avoid the use of excessive quantities of grinding paste and see that it remains in the region of the valve seating only.

A light coil spring placed under the valve head will assist considerably in the process of grinding. The valve should be ground to its seat with a semi-rotary motion and occasionally allowed to rise by the pressure of the light coil spring. This assists in spreading the paste evenly over the valve face and seat. It is necessary to

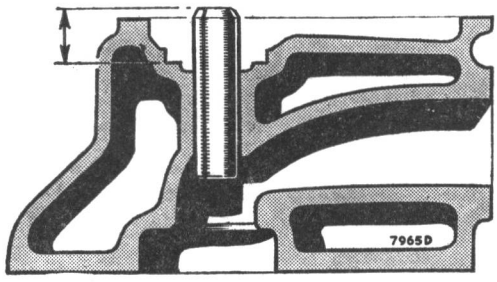


Fig. A.7

When fitting valve guides they must be driven in until they are $\frac{19}{32}$ in. (15·08 mm.) above the machined face of the valve spring seat

carry out the grinding operation until a dull, even, mat surface free from blemish is produced on the valve seat and valve face.

On completion, the valve seat and ports should be cleaned with a rag soaked in paraffin (kerosene), dried, and then thoroughly cleaned by compressed air. The valves should be washed in paraffin (kerosene) and all traces of grinding paste removed.

Refer to Section A.11 for details of valve refitting.

Section A.13

VALVE GUIDES

Removing

Remove the cylinder head as shown in Section A.9.

Remove the appropriate valve and spring as in Section A.11. Rest the cylinder head with its machined face downwards on a clean surface and drive the valve guide downwards into the combustion space with a suitable-sized drift. This should take the form of a hardened-steel punch $\frac{7}{16}$ in. (11 mm.) in diameter and not less than 4 in. (10 cm.) in length, with a locating spigot $\frac{9}{32}$ in. (7·14 mm.) diameter machined on one end for a length of 1 in. (2·5 cm.) to engage the bore of the guide.

Refitting

When fitting new valve guides they should be driven in from the top of the cylinder head. The inlet valve guides must be inserted with the largest chamfer at the top, and the exhaust valve guides should have their counter-bored ends at the bottom. The valve guides should be driven into the combustion spaces until they are $\frac{19}{32}$ in. (15·08 mm.) above the machined surface of the valve spring seating (see Fig. A.7).

Section A.14

TAPPETS

Removing

Remove the carburetter (see Section A.4) and the rocker cover.

Remove the manifold (see Section A.6).

Disconnect the high-tension leads from the sparking plugs.

Remove the rocker assembly as in Section A.7 and withdraw the push-rods, keeping them in their respective positions to ensure their replacement onto the same tappets. Remove the tappet covers and lift out the tappets, also keeping them in their correct order to assist in replacing them in their original locations.

Fitting

Refitting is a reversal of the removal sequence.

New tappets should be fitted by selective assembly so that they just fall into their guides under their own weight when lubricated.

Assembly is a reversal of the above procedure, but care should be taken to see that the tappet cover joints are oil-tight and that the rockers are adjusted to give the correct valve clearance.

Section A.15

VALVE ROCKER ADJUSTMENT

If the engine is to give its best performance and the valves are to retain their maximum useful life it is essential to maintain the correct valve clearance. Accordingly it is recommended that the clearance be checked at regular intervals as stated in the Passport to Service and any necessary adjustments made.

The clearance for both the inlet and exhaust valves is ·011 in. (·28 mm.) when the engine is hot. The engine has been designed to operate with this clearance and no departure from it is permissible. An additional ·001 in. (·025 mm.) must be allowed when the engine is cold.

Provision for adjusting the valve clearance is made in the rocker arm by an adjustable screw and locknut.

The rocker adjusting screw is released by slackening the hexagon locknut with a spanner while holding the screw against rotation with a screwdriver. The valve clearance can then be set by carefully rotating the rocker

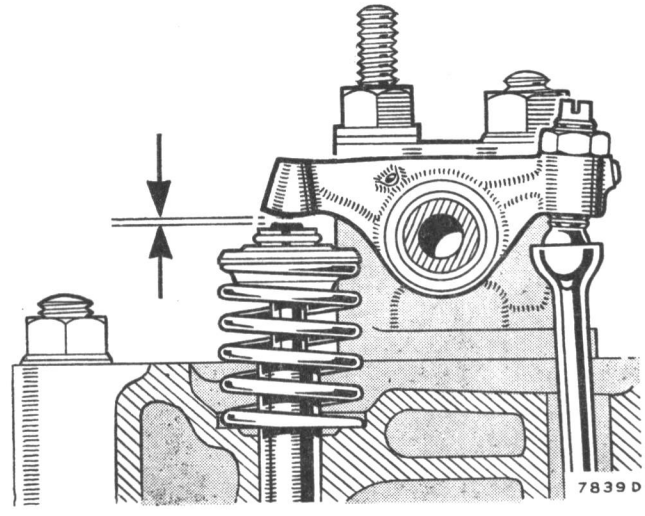


Fig. A.8

The clearance between the valve stem and the valve rocker indicated above must be ·012 in. (·30 mm.) with the engine cold and ·011 in. (·28 mm.) when hot

screw while checking the clearance with a feeler gauge. This screw is then relocked by tightening the hexagon locknut while again holding the screw against rotation.

It is important to note that while the clearance is being set the tappet of the valve being operated upon is on the back of its cam, i.e. opposite to the peak.

As this cannot be observed accurately the rocker adjustment is more easily carried out in the following order, and this also avoids turning the crankshaft more than is necessary.

Adjust No. 1 rocker with No. 8 valve fully open

,,	,,	3	,,	,,	,,	6	,,	,,	,,
,,	,,	5	,,	,,	,,	4	,,	,,	,,
,,	,,	2	,,	,,	,,	7	,,	,,	,,
,,	,,	8	,,	,,	,,	1	,,	,,	,,
,,	,,	6	,,	,,	,,	3	,,	,,	,,
,,	,,	4	,,	,,	,,	5	,,	,,	,,
,,	,,	7	,,	,,	,,	2	,,	,,	,,

Section A.16

DISTRIBUTOR DRIVING SPINDLE

Removing

Remove the distributor as detailed in Section B.6.

Take out the screw securing the distributor housing to the cylinder block and carefully withdraw the housing to avoid damage to the 'O' ring seal, (later models only).

Screw a $\frac{5}{16}$ in. UNF. bolt approximately $3\frac{1}{2}$ in. (89 mm.) long into the tapped end of the distributor drive spindle and withdraw the spindle.

Refitting

Turn the crankshaft until No. 1 piston is at T.D.C. on its compression stroke. When the valves on No. 4 cylinder are 'rocking' (i.e. exhaust just closing and inlet just opening) No. 1 piston is at the top of its compression stroke. If the crankshaft is set so that the '1/4' mark on the flywheel is in line with the pointer on the clutch cover, the piston is exactly at T.D.C.

Screw the $\frac{5}{16}$ in. by $3\frac{1}{2}$ in. UNF. bolt into the threaded end of the distributor drive gear and, holding the drive gear with the slot just below the horizontal and the large offset uppermost, enter the gear. As the gear engages

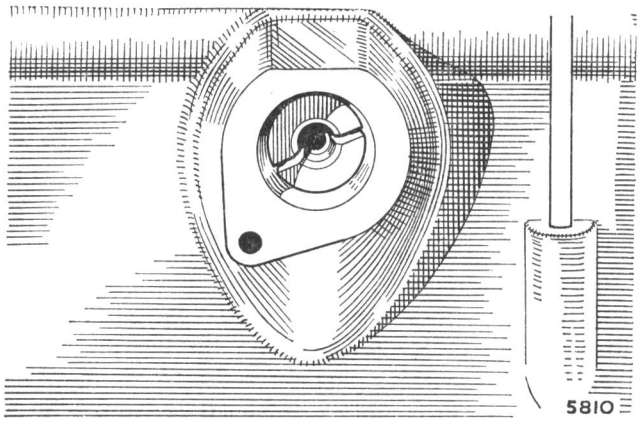


Fig. A.9

The distributor drive with the slot in the correct position and the large offset uppermost

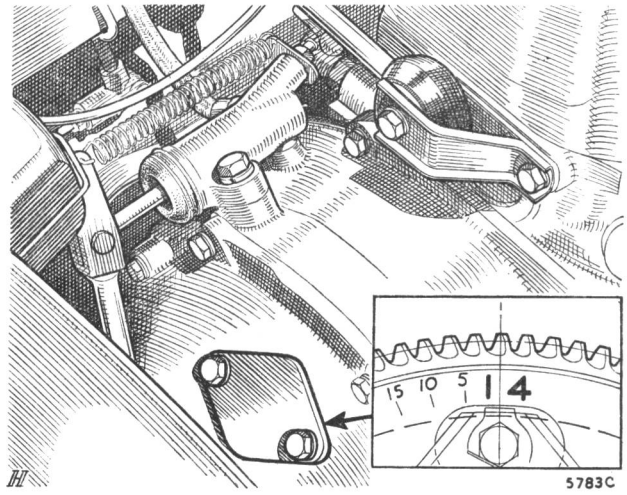


Fig. A.10

The timing marks on the flywheel can be seen with the aid of a mirror after removing the inspection cover. T.D.C. position is indicated by the mark '1/4'. Marks giving 5°, 10°, and 15° B.T.D.C. are also provided

with the camshaft the slot will turn in an anti-clockwise direction until it is approximately in the one o'clock position.

Remove the bolt from the gear and insert the distributor ensuring that the 'O' ring seal if fitted is not damaged. Secure the housing with the special screw and washer, ensure that the head of the screw does not protrude above the face of the housing.

Refit the distributor, referring to Section B.6 if the clamp plate has been released.

Section A.17

FLYWHEEL AND CLUTCH

Removing

Disconnect the leads from the coil or solenoid switch (as fitted), extract the two mounting screws, and remove the coil or solenoid switch from the flywheel housing.

Remove the starter as in Section N.5.

Withdraw the split pin from the clutch operating lever pivot, release the tension spring, pull the push-rod from the hydraulic slave cylinder, and remove the lever assembly from the clutch cover.

Withdraw the slave cylinder mounting screws and secure the cylinder against the engine bulkhead.

Remove the exhaust pipe clamp and the radiator cowling steady bracket.

Remove the two nuts and set screws securing the engine mounting to the sub-frame side-member and extract the nine set screws securing the clutch cover to the flywheel housing.

Raise the engine with suitable lifting equipment sufficient only to enable the cover to be removed. Make sure that the fan blades do not make contact with and damage the radiator core.

Undo the three retaining nuts and remove the clutch thrust plate from the pressure spring housing.

It is essential that the crankshaft is turned to T.D.C. on Nos. 1 and 4 cylinders before removing the flywheel.

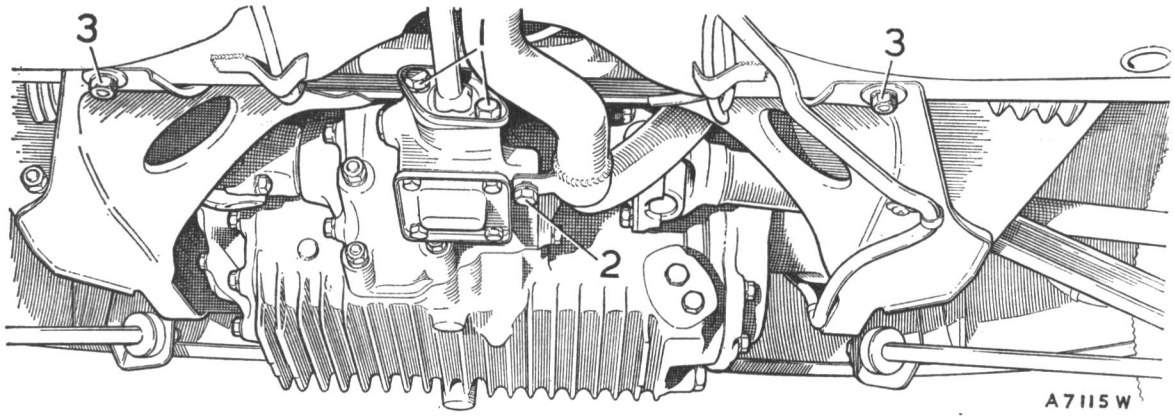


Fig. A.11

The front sub-frame and transmission casing viewed from beneath the car, showing (1) *the gear change lever retaining screws,* (2) *the exhaust system fixing point,* (3) *the front sub-frame rear mounting point (four set screws)*

In this position the 'C' washer locating the primary gear is fitted with the bridge linking the two flats above the crankshaft and cannot drop. If this precaution is not taken the 'C' washer can fall and become wedged behind the flywheel oil seal and prevent the removal of the flywheel without serious damage to the seal.

Knock up the locking washer and slacken off the flywheel retaining screw three or four threads. Use Service tool 18G 304 together with adaptor set 18G 304M to break the flywheel away from its seating on the taper of the crankshaft.

WARNING.—As the flywheel is pulled from the crankshaft, oil from the annulus at the back of the flywheel oil seal may spill down the face of the flywheel onto the clutch driven plate. This should be observed at the time of removal to avoid assuming that oil has passed the seal whilst the vehicle was in service. Every care must be taken to maintain the flywheel in a vertical position during the removal operation to prevent oil from this source wetting the clutch facings.

Screw the three studs from the adaptor set into the flywheel through the recessed holes in the clutch spring housing. Fit the plate of tool 18G 304 over the three studs and screw the nuts onto the studs, screwing them down evenly so that the plate remains parallel with the flywheel. Insert the short centre screw and withdraw the flywheel. Remove the extractor immediately the taper is broken.

Unscrew and remove the flywheel retaining screw and the keyed driving washer. Withdraw the flywheel and clutch as a complete assembly. The clutch dismantling details are given in Section E.1.

NOTE.—If a rubber plug is fitted ahead of the flywheel retaining screw and oil leakage is suspected at this point, a new brass taper plug must be fitted in the end of the crankshaft drilling and the rubber plug discarded.

Later engines are fitted with non-lubricated bushes in the primary gear, with no oil feed from the crankshaft.

With this type of bush no oil seal is fitted to the flywheel.

The crankshaft primary gear cannot be removed from the crankshaft without the flywheel housing being removed; this operation is covered in Section A.22.

Refitting is a reversal of the removal procedure.

The flywheel oil seal (if fitted) must be lubricated prior to reassembly to prevent burning up of the sealing lip before adequate lubricant can reach this point.

Lightly wipe the crankshaft primary gear splines with Duckhams M.B. grease.

Wipe all traces of oil from the crankshaft and flywheel tapers, and make sure that the primary gear retaining 'C' washer is positioned correctly in its groove. It is essential that these tapers are degreased and completely dry before the flywheel is mounted. Turn the crankshaft to bring the circlip to the top of the shaft to obviate the possibility of it falling out of position and thereby preventing the flywheel from being pushed fully onto the crankshaft taper. Make certain that the flywheel retaining screw is tightened up to a torque reading of 110 to 115 lb. ft. (15·21 to 15·9 kg. m.).

Section A.18

FRONT SUB-FRAME AND ENGINE ASSEMBLY

Removing

Unscrew the hexagon plug and remove the anti-rattle spring and plunger from the gear change extension casing.

Remove the two set screws securing the change speed lever retaining plate to the casing and pull the lever out of the casing from inside the car.

Detach the earth lead from the battery.

Detach the bonnet from the bonnet hinges and remove the bonnet.

Disconnect the heater inlet and outlet hoses (if applicable).

Remove the carburetter as in Section A.4.

Disconnect the oil pressure warning light lead from the switch on the cylinder block or remove the oil gauge pipe union nut (as fitted).

Release the leads from the stop light switch, coil, dynamo, and distributor. Remove the distributor cap complete with sparking plug and coil leads. Remove the cable from the starter motor and from the retaining clip on the sub-frame; pull the cable clear of the frame. Release the earth cable from its location on the clutch cover.

Unscrew the sleeve nut and release the speedometer cable from the back of the instrument.

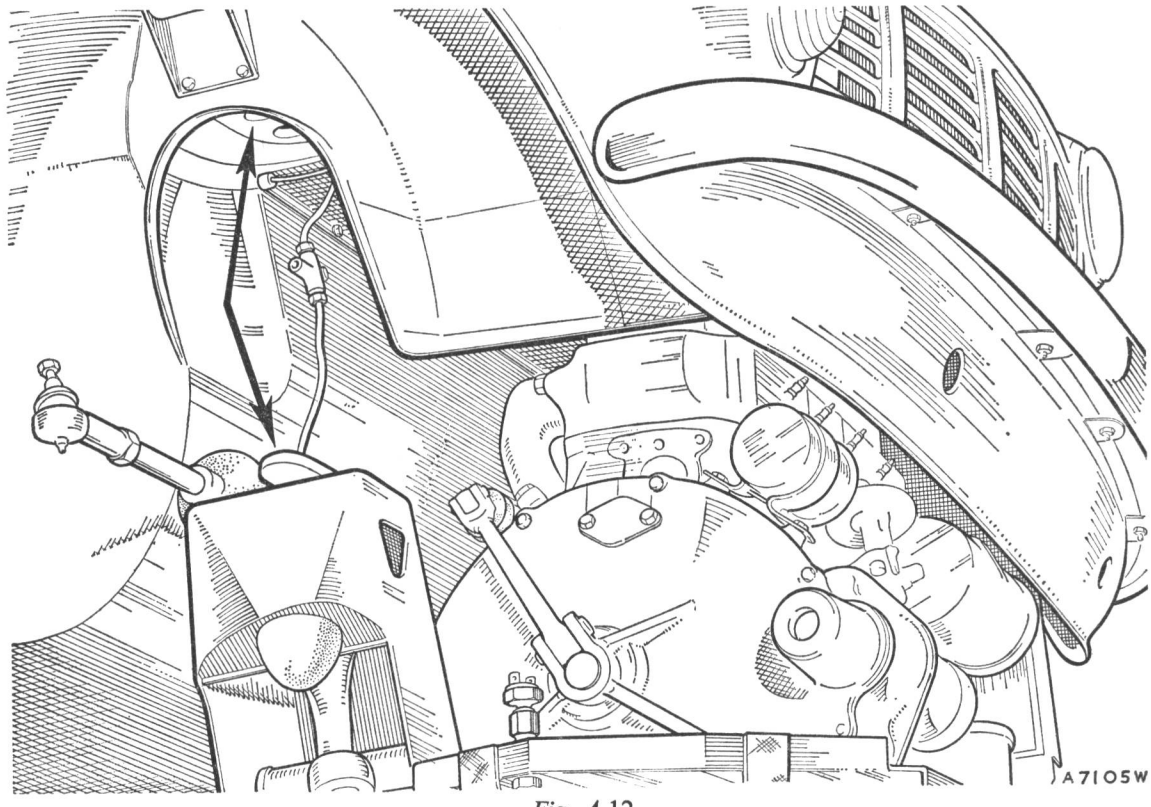


Fig. A.12

The front sub-frame and engine disconnected as in Section A.18, and the body raised to enable the engine and sub-frame to be removed as a complete assembly

Disconnect the hydraulic brake supply pipe at the three-way union on the engine bulkhead and plug the union with a clean $\frac{3}{8}$ in. UNF. screw to prevent the system draining.

Remove the exhaust system as detailed in Section A.5.

Support the body with suitable slings underneath each front wing.

Withdraw the two set screws securing the slave cylinder to the flywheel housing, release the lever tension spring, pull the push-rod from the cylinder, and secure the slave cylinder against the engine bulkhead.

Disconnect the steering rack ball ends from the steering levers and remove the telescopic dampers.

Release the engine tie-rod from the bracket on the rear of the cylinder block.

Depressurize and evacuate the models fitted with Hydrolastic suspension (Section H.8) and disconnect both hoses.

Support the engine beneath the transmission casing.

Knock back the lock plate tabs and withdraw the four body to sub-frame bolts or remove the nuts if studs are fitted, two on each side of the bulkhead cross-member. Take out the four set screws securing the rear of the sub-frame to the front floor and the two screws securing the front of the frame to the bottom of the grille panel.

Lift the body clear of the engine and withdraw the sub-frame and engine assembly. Care should be taken when lifting the body to avoid damaging the radiator and cowling; also the steering rack rubber gaiters.

Removing engine from sub-frame

Drain the oil from the transmission casing.

Disconnect the drive shafts at the differential.

With the sub-frame supported under both side-members, take the weight of the engine with suitable lifting tackle and remove the two screws securing each engine mounting to the sub-frame. Lift the engine out of the frame.

The approximate weight of the engine and sub-frame is 428 lb. (193 kg.).

Note the paper gaskets fitted between the engine mountings, the sub frame, and the clutch cover on engines up to Engine No. 4354. It is essential that gaskets are refitted to all engine units up to this serial number.

Refitting

Refitting the engine to the sub-frame and the sub-frame to the vehicle is a reversal of the removal procedure.

Make certain that the change speed lever is pulled up into the car interior before the body is lowered onto the frame; ensure that the electric lead to the rear of the car is not trapped between the body and the sub-frame.

Tighten the steering-arm ball joint nut to the correct torque loading (see **'GENERAL DATA'**).

Bleed the hydraulic brake system when reassembly is completed.

Section A.19

TIMING COVER

Removing

Remove the engine as detailed in Section A.34.

On later models fitted with a split fan cowling this

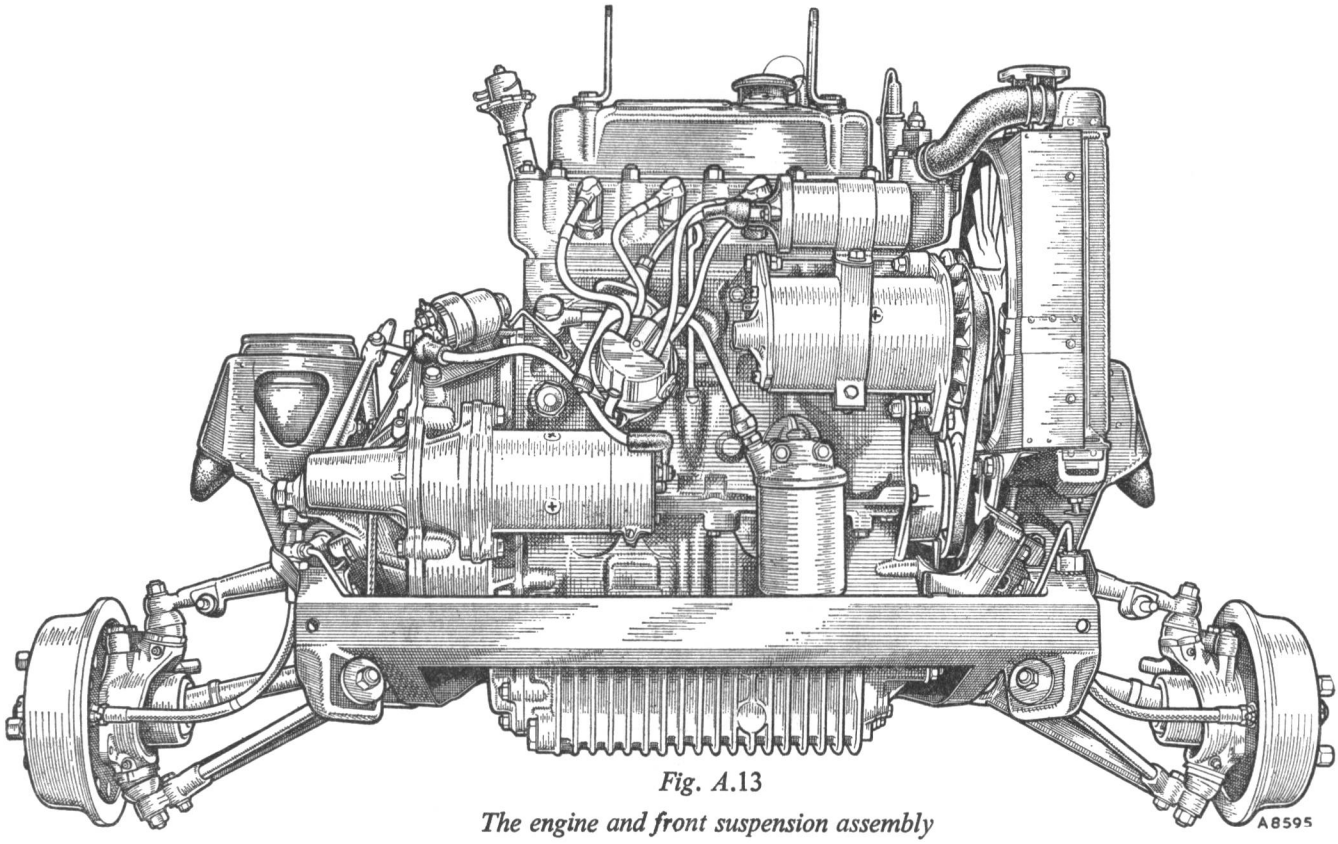


Fig. A.13

The engine and front suspension assembly

operation can be carried out without removing the engine.

Remove the radiator as in Section C.3.

Slacken the dynamo attachment bolts and the adjusting screw; remove the fan belt.

Bend back the tab on the crankshaft pulley locking washer, remove the pulley securing screw, and carefully lever the pulley from the crankshaft.

Unscrew the 10 set screws on the timing case flange and remove the cover.

Refitting

Reverse the removal procedure when refitting the cover.

The oil seal in the cover must be renewed if it shows signs of damage or deterioration. Use Service tool 18G 134 with adaptor 18G 134 BD. A new cover gasket should also be fitted.

It should be noted that the oil thrower behind the crankshaft pulley is fitted with its concave facing forward.

When refitting the cover it is important to ensure that the seal is centralized on the crankshaft and Service tool 18G 138 is available for the purpose.

If a rubber seal is fitted to the cover fill the annular groove between the lips with grease.

In the absence of the tool, the crankshaft pulley can be used as follows.

Lubricate the hub of the pulley and push it into the seal, at the same time turning it to avoid damaging the felt or the lips of a rubber seal. Slide the pulley onto the shaft with the keyway in line with the key in the crankshaft. Turn the cover as necessary to align the set screw holes with those in the crankcase, taking care not to strain the cover against the flexibility of the seal; insert the cover set screws and tighten up. Refit and tighten the pulley securing screw and locking washer.

Section A.20

TIMING GEARS

Removing

Remove the timing cover and oil thrower as in Section A.19.

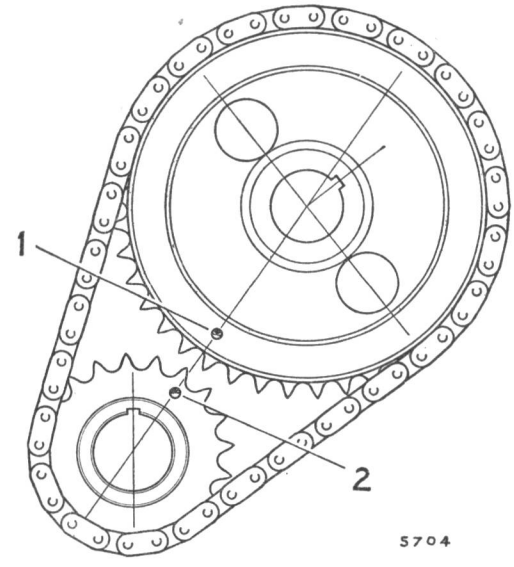


Fig. A.14

The timing gears assembled into the timing chain with the two marks on the gears opposite each other

Unlock and remove the camshaft chain wheel nut and remove the nut and lock washer. Note that the locating tag on the lock washer fits into the keyway of the camshaft chain wheel.

The camshaft and crankshaft chain wheels may now be removed, together with the timing chain, by easing each wheel forward a fraction at a time with suitable small levers. Note the packing washers immediately behind the crankshaft gear.

Refitting

When reassembling, replace the same number of washers as was found when dismantling unless new camshaft or crankshaft components have been fitted which will disturb the alignment of the two gear wheels. To determine the thickness of washers required place a straight-edge across the sides of the camshaft wheel teeth and measure with a feeler gauge the gap between the straight-edge and the crankshaft gear.

When replacing the timing chain and gears set the crankshaft with its keyway at T.D.C. and the camshaft with its keyway approximately at the one o'clock position as seen from the front. Assemble the gears into the timing chain with the two marks on the gear wheels opposite to each other, as in Fig. A.14. Keeping the gears in this position, engage the crankshaft gear keyway with the key on the crankshaft and rotate the camshaft until the camshaft gear keyway and key are aligned. Push the gears onto the shafts as far as they will go and secure the camshaft gear with the lock washer and nut.

Refit the early type oil thrower concave side forward or the later type thrower with the face marked 'F' facing forward. Reassemble the remaining components as detailed in Sections A.19 and A.40.

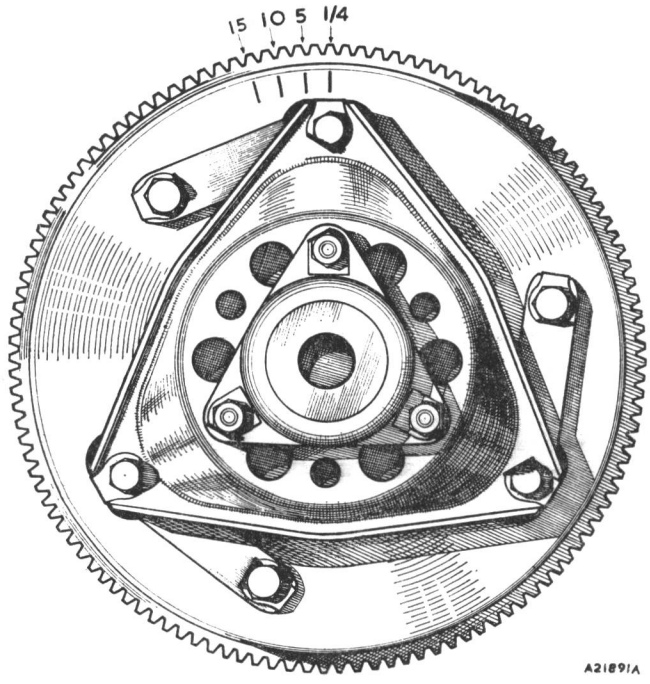


Fig. A.15

The flywheel and clutch assembly, showing the position of the 15°, 10°, *and* 5° *B.T.D.C. and the* 1/4 *T.D.C. markings*

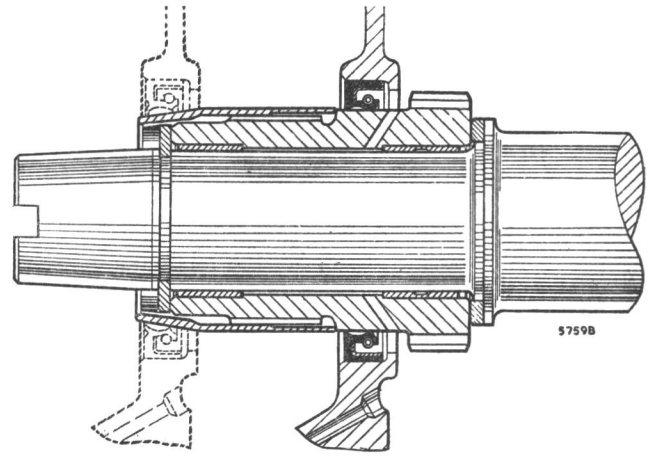


Fig. A.16

The Service tool 18G 570 *positioned over the clutch splines of the crankshaft primary gear to prevent damage to the lip of the oil seal*

Section A.21

VALVE TIMING

Set No. 1 cylinder inlet valve to ·019 in. (·48 mm.) clearance with the engine cold, and then turn the engine until the valve is about to open.

The 5° B.T.D.C. indicating mark on the flywheel should then be opposite the pointer in the clutch cover inspection aperture, i.e. the No. 1 valve should be about to open and No. 4 piston will be 5° B.T.D.C. on its compression stroke.

NOTE.—Do not omit to reset the inlet valve clearance to ·011 in. (·28 mm.) with the engine hot (·012 in. [·30 mm.] cold) when the timing check has been completed. The clearance of ·019 in. (·48 mm.) is necessary to bring the opening position of the valve to 5° B.T.D.C. It is not possible to check the valve timing accurately with the valve rockers set at the normal running clearance.

Section A.22

FLYWHEEL HOUSING

Removing

Remove the engine as in Section A.34.

Remove the clutch cover-plate and extract the flywheel and clutch assembly as in Section A.17.

Slacken off and remove the six set screws and nine stud nuts securing the flywheel housing to the cylinder block and transmission case. Take particular note of the position in which the screws are fitted to facilitate their replacement in the same positions from which they were removed.

Extra care must be taken when withdrawing the housing to avoid damaging the lips of the seal on the clutch plate splines of the crankshaft primary gear. The sleeve shown in Fig. A.16 should be pushed over the gear splines and held firmly in this position while the housing is withdrawn.

Refitting

Refitting is a reversal of the dismantling procedure, with special attention being given to the following points.

Make certain that the crankshaft primary gear inner thrust washer is refitted with its chamfered bore against the crankshaft flange.

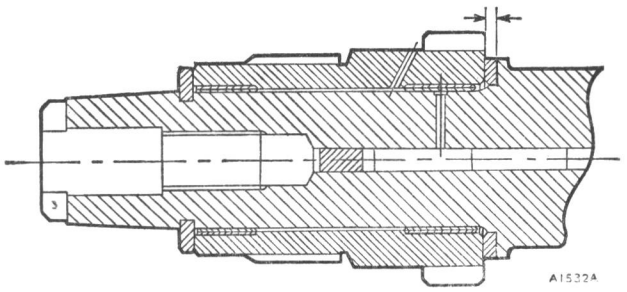


Fig. A.17

The crankshaft primary gear with lubricated bushes must be assembled with the correct running clearance of between ·003 and ·006 in. (·076 and ·152 mm.). Measure the gap indicated and use the following table to determine the correct thickness of the thrust washer required to obtain this clearance

When gap is	*Use washer thickness*	*Part No.*
·1295 to ·1315 in. (3·27 to 3·34 mm.)	·125 to ·127 in. (3·17 to 3·22 mm.)	22A 83
·1315 to ·1335 in. (3·34 to 3·39 mm.)	·127 to ·129 in. (3·22 to 3·27 mm.)	22A 238
·1335 to ·1345 in. (3·39 to 3·42 mm.)	·129 to ·131 in. (3·27 to 3·32 mm.)	22A 239

Check the primary gear running clearance, and adjust any discrepancy from the recommended figure of between ·003 and ·006 in. (·076 and ·152 mm.) by selective assembly of the thrust washer, as indicated in Fig.A.17.

Thoroughly clean the joint faces of the cylinder block, transmission casing, and the flywheel housing. All traces of the old joint must be removed and a new gasket fitted. Use only a gasket as supplied by B.M.C. Service Ltd.; this is most important.

Renew the crankshaft primary gear oil seal if it shows signs of damage or oil leakage, using Service tool 18G 134 and adaptor 18G 134 BC. This operation requires great care. Damaged seals can be detected by careful examination of the sealing knife edge. Seals with imperfections must be renewed. If the engine has covered a large mileage new seals should be fitted as a matter of routine. Pack the first motion shaft bearing rollers with grease to prevent them falling out of position as the housing is being refitted. Use Service tool 18G 570 over the splines of the primary gear to prevent damage to the seal (see Fig. A.16). Later engines are fitted with a red silicon rubber oil seal and Service tool 18G 1043 must be used for assembly with this seal. The earlier protector sleeve 18G 570 must not be used with the silicon rubber seal.

Lubricate the lips of the oil seal prior to reassembly.

The two pilot bars supplied as part of either tool set should be screwed into the two bottom tapped holes in the crankcase to pilot the housing into position and take the weight off the lip of the seal.

NOTE.—Should it be necessary to renew the gear train, the transmission casing must be removed to enable the idler gear end-float measurement to be taken (see Sections A.23 and F.2).

The three set pins securing the housing to the bottom of the transmission casing have UNC. threads and must be refitted in this position. Make certain that the correct short set pin is fitted at the right-hand top position in the housing. This is most important as a long screw could possibly cause damage to the oil gallery in the cylinder block.

The flywheel housing bolts and stud nuts should be tightened with a torque spanner to the correct torque figure (see **'GENERAL DATA'**). This figure gives the desired compression of the gasket to obtain a compressed thickness of ·030 in. (·76 mm.). There is a small cut-away in the housing gasket which enables a feeler gauge to be inserted between the two machined faces to check that the gasket has been compressed to its correct thickness.

Section A.23

TRANSMISSION

Removing

Remove the engine as detailed in Section A.34.

Withdraw the eight set screws, remove the clutch cover-plate, and extract the flywheel and clutch as in Section A.17.

Remove the starter motor.

Remove the flywheel housing as in Section A.22.

Withdraw the 10 set screws and two nuts from the flange of the transmission case, taking due note of the length of the screws and the positions in which the shorter screws are fitted. Lift the engine with suitable lifting equipment to separate the engine from the transmission case.

Details of dismantling are given in Section F.1.

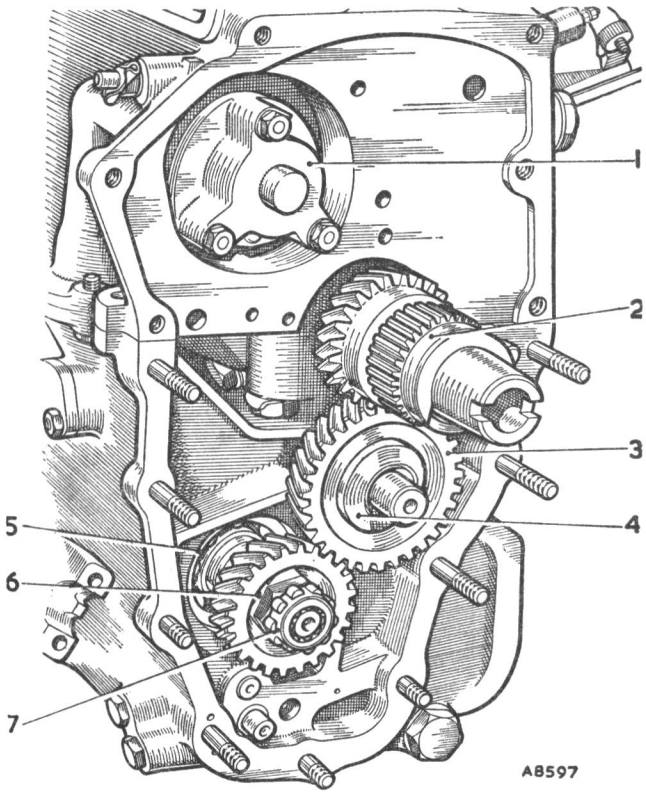


Fig. A.18

The engine and transmission assembly with the flywheel housing removed, showing the gear train to the first motion shaft

1. Oil pump.
2. Crankshaft primary gear.
3. Idler gear.
4. Idler gear thrust washer.
5. First motion shaft bearing.
6. First motion shaft driving gear.
7. Roller bearing.

Refitting

Refitting is a reversal of the removal sequence, with particular attention being given to the following points.

Thoroughly clean all joint faces of the transmission case, crankcase, and flywheel housing. All traces of damaged joints must be removed.

Should it be necessary to fit a new gear train, the end-float of the idler gear must be checked before the transmission case is refitted (see Section F.2).

When refitting the transmission case and flywheel housing screw up the set screws and nuts until they are finger tight, and then tighten them down a turn at a time to ensure an even pressure all round. This is most important, not only to ensure a good oiltight joint but to keep the correct relationship between the crankshaft primary gear, the idler gear, and the first motion shaft driving gears.

Make certain that the front bearing cork oil seal remains correctly positioned as the engine is being lowered onto the casing.

Insert the short sump to crankcase screw, located near the change speed remote-control shaft boss, before the crankcase is lowered onto the transmission case, and screw it up as far as possible before the flanges are finally brought together.

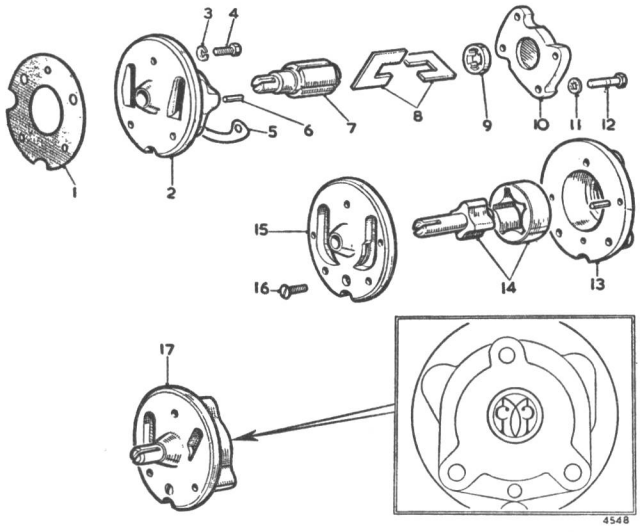


Fig. A.19

The three types of oil pump which may be fitted

Burman

1. Joint washer.
2. Pump body.
3. Washer.
4. Set screw.
5. Lock plate.
6. Dowel.
7. Rotor.
8. Vane.
9. Sleeve.
10. Body cover.
11. Shakeproof washer.
12. Screw—cover to body.

Hobourn-Eaton

13. Body
14. Shaft and rotor.
15. Cover.
16. Screw—cover to body.

Concentric Engineering Co.

17. Pump (serviced as assembly only).

Section A.24

OIL PUMP

Removing

Remove the engine as detailed in Section A.34.

Remove the flywheel and clutch assembly and the flywheel housing as detailed in Sections A.17 and A.22.

Bend back the locking washers and remove the three ¼ in. UNF. screws securing the pump to the crankcase. Withdraw the pump, noting the position of the slot in the driving shaft in order to assist in replacement.

Dismantling and reassembling (Hobourn-Eaton)

The pump cover is located on the pump body by two dowels and a machine screw. When the screw is removed the pump can be separated for examination and replacement where necessary.

Dismantling and reassembling (Burman)

Unscrew and remove the two screws and spring washer securing the cover to the pump body. Remove the cover and withdraw the rotor and vane assembly. Prise off the retaining sleeve from the end of the rotor and extract the vanes.

The component parts of the pumps are shown in Fig. A.19.

Reassembly is a reversal of the dismantling procedure.

Refitting

The refitting of the pump to the cylinder block is a reversal of the removal procedure; particular attention must, however, be given to the fitting of the paper joint washer to ensure that the intake and delivery ports are not obstructed. Use a new paper joint washer if the old one is damaged in any way.

Section A.25

CAMSHAFT

Removing

Remove the engine as detailed in Section A.34.

Remove the rocker assembly (Section A.7), the inlet and exhaust manifold (Section A.6), and the timing cover and gears (Sections A.19 and A.20).

Disconnect the high-tension leads from the coil and sparking plugs, and the low-tension wire from the side of the distributor.

Withdraw the push-rods, remove the tappet covers, and lift out the tappets (Section A.14).

Disconnect the suction advance unit pipe from the distributor and take out the two bolts with flat washers securing the distributor to the housing. Do not slacken the clamping plate bolt or the ignition timing setting will be lost.

Withdraw the distributor.

Take out the bolt securing the distributor housing to the cylinder block. Using one of the tappet cover bolts as an extractor screwed into the tapped end of the distributor drive spindle, withdraw the spindle.

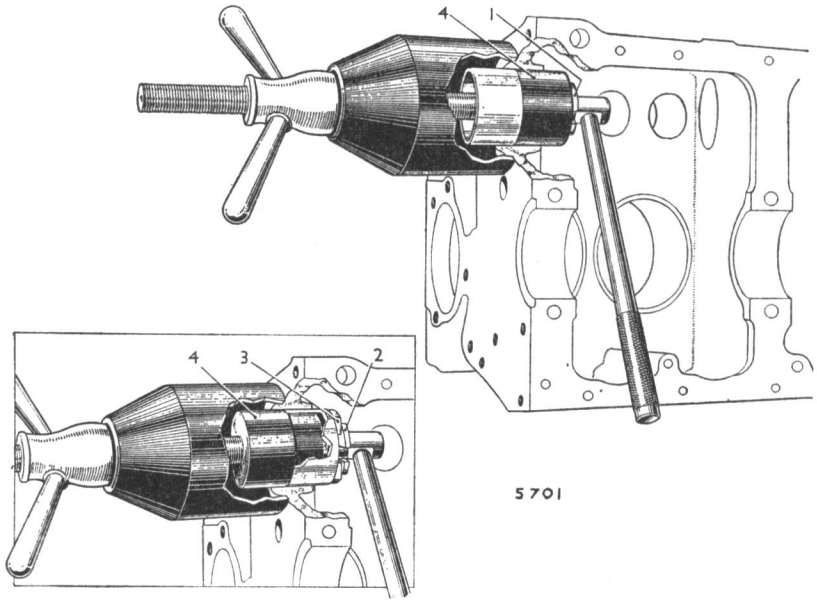


Fig. A.20

Removing a camshaft front liner, using adaptor 18G 124 K in conjunction with service tool 18G 124 A. Inset shows the bearing being replaced

1. 'C' washer.
2. 'C' washer.
3. 'D' washer.
4. Adaptor 18G 124 K.

Take out the three set screws and shakeproof washers which secure the camshaft locating plate to the cylinder block and withdraw the camshaft.

Should the front camshaft bearing clearance be excessive, a new bearing liner must be fitted, and as this will entail line-reamering after fitting, both the flywheel housing and the transmission case must be removed as in Sections A.22 and A.23.

Removing a liner

A worn liner can be removed and a new liner pulled into the cylinder block with Service tool 18G 124 A together with adaptor 18G 124 K.

Place the adaptor in the liner from inside the cylinder block and screw the centre screw of the tool through the adaptor from the front of the block. Position the 'C' washer on the flat at the end of the screw and the tommy-bar into the small hole behind the washer to prevent the screw turning.

Continued tightening of the large wing nut will withdraw the worn liner.

Liner fitting

Place the new liner on the small diameter of the adaptor and position the adaptor in the liner bore from inside the cylinder block, lining up the oil holes in the liner and bore. Place the 'D' washer in position behind the liner and pass the centre screw of the tool through the adaptor and the 'D' washer, and tighten up the screw. Secure the tommy-bar in the hole at the rear end of the centre screw to prevent it from turning, and tighten the wing nut to draw the liner squarely into position.

Liner reaming

After fitting a new front liner it must be line-reamed to size, using Service tool 18G 123 A in conjunction with the appropriate pilots and cutter shown at the end of Section A.

Fit the pilots 18G 123 AH and 18G 123 AJ into the centre and rear camshaft bearing bores, push the cutter onto the arbor of tool 18G 123 A, and locate it in position No. 8. A peg retained in the centre groove of the cutter by a spring clip will locate in the arbor to hold the cutter

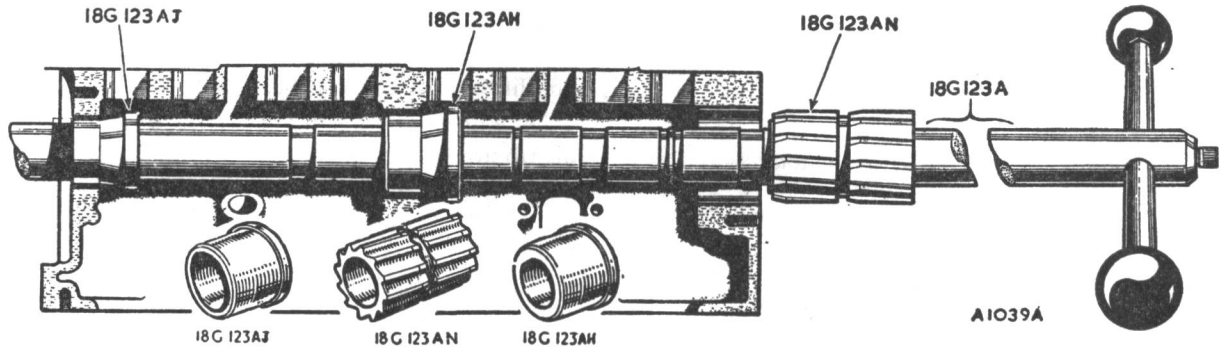


Fig. A.21

The camshaft liner reamer, with the pilots and cutters positioned to ream the front liner

in the desired position. The cutter is made up of a combined roughing and finishing cutter, and care must be taken to ensure that it is placed on the arbor with the relieved flutes of the roughing cutter to enter the liner first.

Pass the arbor through the camshaft bore and the two pilots and commence to ream, always turning in a clockwise direction. Do not force the reamer through the liners, proceed gently, and keep the cutter dry. Swarf should be cleared away during the operation, preferably with air-blast equipment.

When the cutter has passed through the liner release its locating peg from the arbor and hold it inside the block while the arbor is withdrawn.

NOTE.—On no account must the cutter be brought through the reamed hole on the arbor.

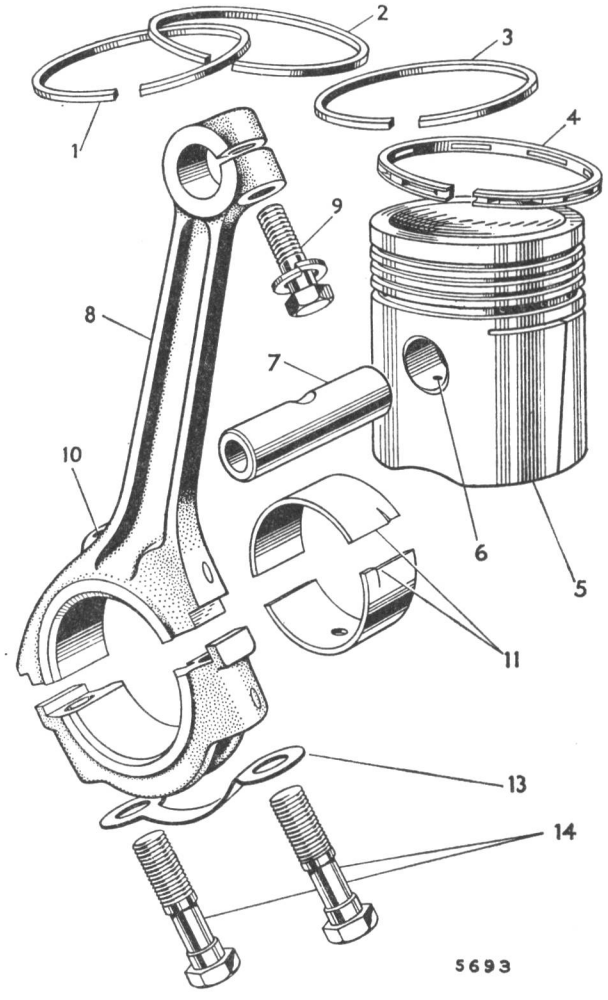


Fig. A.22

A connecting rod and piston assembly

1. Piston ring—parallel.
2. Piston ring—taper.
3. Piston ring—taper.
4. Piston ring—scraper.
5. Piston.
6. Gudgeon pin lubricating hole.
7. Gudgeon pin.
8. Connecting rod.
9. Clamping screw and washer.
10. Cylinder wall lubricating jet.
11. Connecting rod bearing.
13. Lock washer.
14. Set screws.

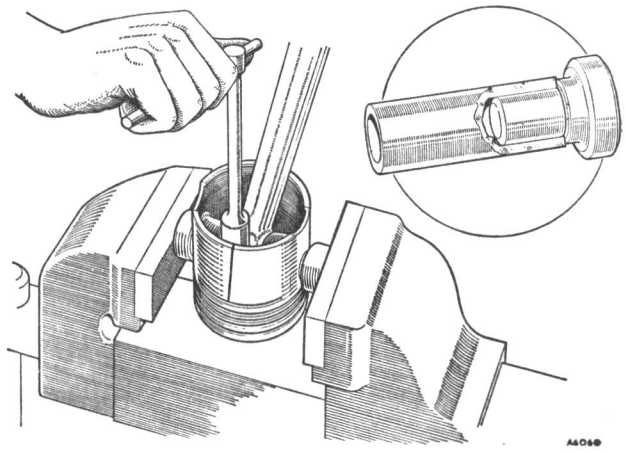


Fig. A.23

The use of special gudgeon pin plugs to hold the connecting rod and piston assembly while the gudgeon pin clamp screw is tightened or loosened is essential

Refitting

Refitting is a reversal of the removal procedure; lubricate the journal with engine oil and refer to Section A.16 when replacing the distributor gear.

Section A.26

PISTONS AND CONNECTING RODS

Removing

Drain the transmission casing and external oil filter.

Remove the engine from the frame (Section A.34).

Remove the flywheel and clutch (Section A.17), flywheel casing (Section A.22), transmission (Section A.23), and cylinder head (Section A.9).

Unlock and remove the big-end bolts and remove the bearing cap. Release the connecting rod from the crankshaft.

Withdraw the piston and connecting rod from the top of the cylinder block and refit the bearing cap. The big-end bearing caps are offset, and the connecting rod assemblies in Nos. 1 and 3 cylinders are interchangeable when new, as are those for Nos. 2 and 4 cylinders. When used parts are replaced after dismantling it is essential that they should be fitted in their original positions. In order to ensure this, mark each cap and connecting rod on the sides which are fitted together with the number of the cylinder from which they were taken.

Dismantling

The gudgeon pin is rigidly held in the split little-end of the connecting rod by a clamp bolt engaging the central groove of the gudgeon pin.

Before the piston and gudgeon pin can be dismantled from the connecting rod it is necessary to remove the clamp screw. To enable the assembly to be held in a vice for this operation without damage, special holding plugs

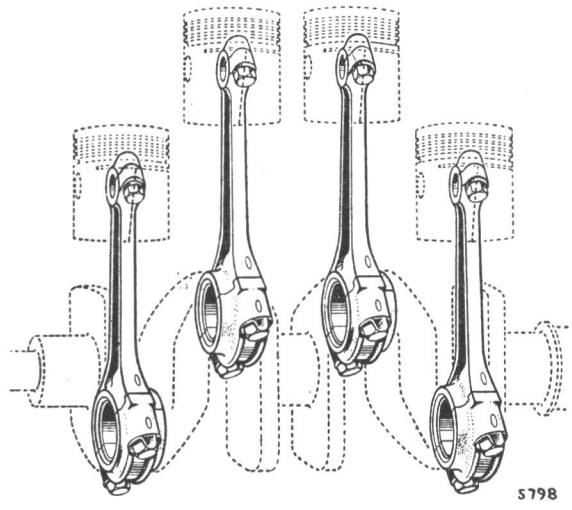


Fig. A.24

The correct assembly of connecting rods to the pistons and crankshaft

should be inserted in each end of the gudgeon pin (see Fig. A.23).

Unscrew the gudgeon pin clamp screw and remove it completely. Push out the gudgeon pin.

Reassembling

A certain amount of selective assembly must be used when fitting new gudgeon pins. They must be a thumb-push fit for three-quarters of their travel, to be finally tapped home with a rawhide mallet. This operation must be carried out with the piston and gudgeon pin cold.

When reassembling, particular attention must be given to the following points:

(1) That the piston is fitted the same way round on the connecting rod. The crown of the piston is marked 'FRONT' to assist this and the connecting rod is fitted with the gudgeon pin clamp screw on the camshaft side.

(2) That the gudgeon pin is positioned in the connecting rod so that its groove is in line with the clamp screw hole.

(3) That the clamp screw spring washer has sufficient tension.

(4) That the clamp screw will pass readily into its hole and screw freely into the threaded portion of the little-end, and also that it will hold firmly onto the spring washer.

Refitting

Replacement of the piston and connecting rod is a direct reversal of the above, but the piston ring gaps should be set at 180° to each other.

It is essential that each connecting rod and piston assembly should be replaced in its own bore and fitted the same way round, i.e. with the split skirt opposite to the thrust side and the gudgeon pin clamp screw on the same side as the split skirt, on the camshaft side of the engine. The piston crowns are marked 'FRONT' to facilitate this.

Refit the big-end bearings in their original positions.

The top and bottom halves of new bearings are, however, interchangeable, each being drilled for cylinder wall lubrication.

Section A.27

PISTON RINGS

Removing

If no special piston ring expander is available use a piece of thin steel such as a smoothly ground hacksaw blade or disused ·020 in. (·50 mm.) feeler gauge.

Raise one end of the ring out of its groove. Insert the steel strip between the ring and the piston. Rotate the strip round the piston, applying slight upward pressure to the raised portion of the ring until it rests on the land above the ring grooves. It can then be eased off the piston.

Do not remove or replace the rings over the piston skirt, but always over the top of the piston.

Refitting

Before fitting new rings clean the grooves in the piston to remove any carbon deposit. Care must be taken not to remove any metal or side-play between the ring and the groove will result, with consequent excessive oil consumption and loss of gastightness.

The cylinder bore glazing should be removed before fitting new rings to a worn cylinder bore, using equipment specially designed for this purpose.

Test new rings in the cylinder bore to ensure that the ends do not butt together. The best way to do this is to insert the piston approximately 1 in. (2·54 cm.) into the cylinder bore and push the ring down onto the top of the piston and hold it there in order to keep the ring square with the bore. The correct ring gap is ·006 to ·011 in. (·15 to ·28 mm.).

The second and third rings are tapered and must be fitted with the narrow taper upwards. A letter 'T' is stamped on the narrow face to facilitate identification.

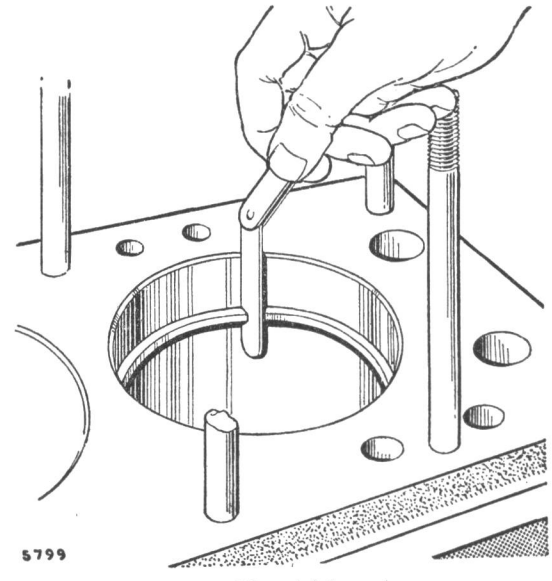


Fig. A.25

Checking the piston ring gap

Section A.28

PISTON SIZES AND CYLINDER BORES

In production, pistons are fitted by selective assembly, and to facilitate this the pistons are stamped with identification figures on their crowns.

A piston stamped with a figure 2 enclosed in a diamond is for a bore bearing a similar stamp.

In addition to the standard pistons there is a range of four oversize pistons available for Service purposes. Oversize pistons are marked with the actual oversize dimensions enclosed in an ellipse. A piston stamped ·020 is suitable only for a bore ·020 in. (·508 mm.) larger than the standard bore and, similarly, pistons with other markings are suitable only for the oversize bore indicated.

The piston markings indicate the actual bore size to which they must be fitted, the requisite running clearance being allowed for in the machining.

After reboring an engine, or whenever fitting pistons differing in size from those removed during dismantling, ensure that the size of the piston fitted is stamped clearly on the top of the cylinder block alongside the appropriate cylinder bore (see Fig. A.26).

Pistons are supplied in the sizes indicated in the following table:

Piston marking	*Suitable bore size*	*Metric equivalent*
STANDARD	2·4778 to 2·4781 in.	62·935 to 62·940 mm.
OVERSIZE		
+·010 in. (·254 mm.)	2·4878 to 2·4881 in.	63·189 to 63·194 mm.
+·020 in. (·508 mm.)	2·4978 to 2·4981 in.	63·443 to 63·448 mm.
+·030 in. (·762 mm.)	2·5078 to 2·5081 in.	63·697 to 63·702 mm.
+·040 in. (1·016 mm.)	2·5178 to 2·5181 in.	63·951 to 63·956 mm.

Section A.29

CRANKSHAFT AND MAIN BEARINGS

The crankshaft is statically and dynamically balanced and is supported in the crankcase by three renewable main bearings. The end-float is controlled by a thrust washer fitted on both sides of the centre main bearing.

Removing

Drain the transmission casing and external oil filter.

Remove the engine as in Section A.34.

Extract the flywheel and clutch assembly (Section A.17) and remove the flywheel housing (Section A.22).

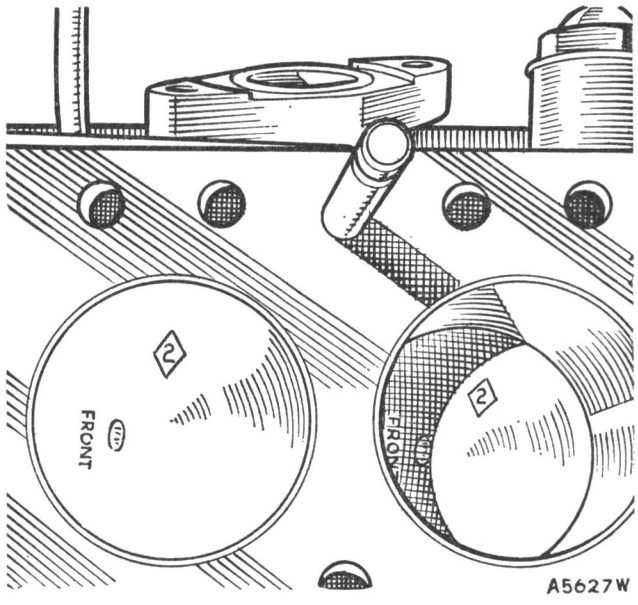


Fig. A.26

The pistons are marked on their crowns with a figure enclosed in a diamond to indicate their size, which should correspond with the similar size stamped on the cylinder block adjacent to the bore. The piston crowns are also stamped 'FRONT' to indicate which way they should be fitted, and 'oversize' pistons have their oversize dimension indicated by figures in a small ellipse

Remove the timing cover and gears (Sections A.19 and A.20), and the transmission (Section A.23).

Lift the cylinder block and place it upside-down in a dismantling fixture. Take out the sparking plugs to facilitate turning the crankshaft.

Check the crankshaft end-float to determine whether renewal of the thrust washers is necessary.

Remove the connecting rod bearing caps and shells, keeping the shells with their respective caps for correct replacement, and release the connecting rod from the crankshaft.

Prise out the retaining circlip to release the primary gear from the flywheel end of the crankshaft.

Withdraw the main bearing caps complete with the bottom bearing shells; caps and their respective shells must be kept together. Note that each main bearing cap is stamped with a number, this number being repeated on the web of the crankcase near the bearing cap. The bottom halves of the two thrust washers will be removed with the centre main bearing cap.

Remove the crankshaft, the two remaining halves of the thrust washers, and the top half-shells of the main bearings from the crankshaft.

Inspecting

Inspect the crankcase main journals and crankpins for wear, scores, scratches, and ovality. If necessary, the crankshaft may be reground to the minimum limits shown under **'GENERAL DATA'**. Main bearings for

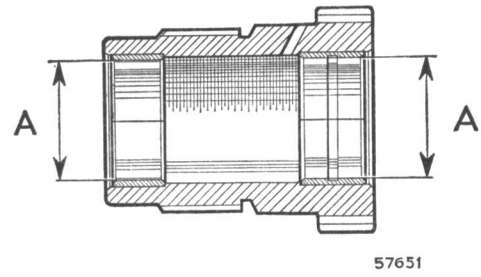


Fig. A.27

A section through the crankshaft primary gear. The bushes (A) *must be line-reamed to* 1·3775 *to* 1·3780 *in.* (34·98 *to* 35·00 *mm.*) *after fitting* (*lubricated bushes only*)

reground crankshafts are available in sizes shown under **'GENERAL DATA'.** Ensure that all oilway countersinks are re-machined to their original dimensions.

Clean the crankshaft thoroughly, ensuring that the connecting oilways between the journals and crankpins are perfectly clear. They can be cleaned out by applying a pressure gun containing fuel or paraffin (kerosene). When clean, inject a thin oil in the same manner.

A rubber plug is fitted into the rear end of the crankshaft ahead of the flywheel retaining screw as an added precaution against the possibility of oil leakage past the normal brass taper plug sealing the oil gallery. On later engines an improved brass plug was fitted and the use of the rubber plug was discontinued.

Thoroughly clean the bearing shells, caps, and housings above the crankshaft.

Examine the bearing shells for wear and pitting and look for evidence of breaking away or picking up. Renew the shells if necessary.

Bearings are prefinished with the correct diametral clearance and do not require bedding in. New bearings should be marked to match up with the markings on the cap, and **on no account should they be filed to take up wear or to reduce running clearance.**

Check the thrust washers for wear on their bearing surfaces and renew if necessary to obtain the correct end-float.

Refitting

Installation of the crankshaft and bearings is a reversal of the removal procedure, particular attention, however, being given to the following points:

(1) Ensure that the thrust washers are replaced the correct way round (the oil grooves should face outwards) and locate the bottom half tab in the slot in the bearing cap.

(2) The bearing shells are notched to fit the recesses machined in the housing and cap.

(3) Remember to fit the packing washers behind the crankshaft timing chain wheel.

(4) Lubricate the bearings freely with engine oil.

(5) Tighten the main bearing screws (see **'GENERAL DATA'** for torque spanner settings).

Section A.30

CRANKSHAFT PRIMARY GEAR (Lubricated Bushes)

Follow the flywheel housing removal procedure given in Section A.22 to gain access to the primary gear. Extract the retaining 'C' washer and withdraw the gear from the crankshaft.

Should the bushes fitted to the bore of the gear become worn, they can be removed and new bushes pressed into position. Burnish-ream in line to the dimensions given in Fig. A.27.

When refitting, make certain that the correct running clearance of ·003 to ·006 in. (·076 to ·152 mm.) is maintained between the inner face of the 'C' washer and the primary gear. If the clearance is outside these limits, select and fit the appropriate washer from the size range shown under the caption to Fig. A.17.

The crankshaft primary gear is pressure-lubricated through drillings in the crankshaft.

Section A.31

VALVE SEAT INSERTS

Should the valve seatings become so badly worn or pitted that the normal workshop cutting and refacing tools cannot restore them to their original standard of efficiency, special valve seat inserts can be fitted.

The seatings in the cylinder head must be machined to the dimensions given in Fig. A.28. Each insert should have an interference fit of ·0025 to ·0045 in. (·063 to ·11 mm.) and must be pressed and not driven into the cylinder head.

After fitting, grind or machine the new seating to the dimensions given in Fig. A.28. Normal valve-grinding may be necessary to ensure efficient valve-seating.

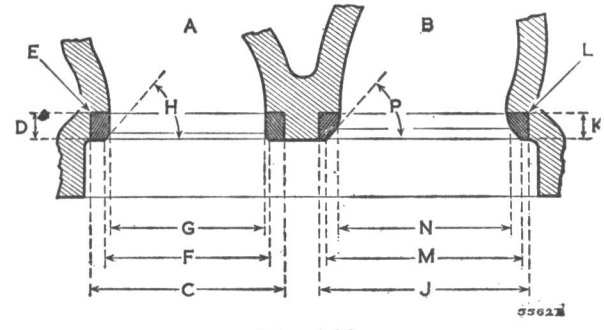


Fig. A.28

Valve seat machining dimensions

Exhaust (A)	Inlet (B)
C. 1·124 to 1·125 in. (28·55 to 28·58 mm.).	J. 1·187 to 1·188 in. (30·16 to 30·17 mm.).
D. ·186 to ·188 in. (4·72 to 4·77 mm.).	K. ·186 to ·188 in. (4·72 to 4·77 mm.).
E. Maximum radius ·015 in. (·38 mm.).	L. Maximum radius ·015 in. (·38 mm.).
F. 1·0235 to 1·0435 in. (25·99 to 26·50 mm.).	M. 1·0855 to 1·1055 in. (27·58 to 28·07 mm.).
G. ·844 in. (21·43 mm.).	N. 1·000 to 1·006 in. (25·4 to 25·55 mm.).
H. 45°.	P. 45°.

Section A.32

FLYWHEEL STARTER RINGS

To remove the old starter ring from the flywheel flange split the ring gear with a cold chisel, taking care not to damage the flywheel. Make certain that the bore of the new ring and its mating surface on the flywheel are free from burrs and are perfectly clean.

To fit the new ring it must be heated to a temperature of 300 to 400° C. (575 to 752° F.), indicated by a light-blue surface colour. Do not exceed this temperature, otherwise the temper of the teeth will be affected. The use of a thermostatically controlled furnace is recommended. Place the heated ring on the flywheel with the lead of the ring teeth towards the flywheel register (see Fig. A.29). The expansion will allow the ring to be fitted without force by pressing or tapping it lightly until the ring is hard against its register.

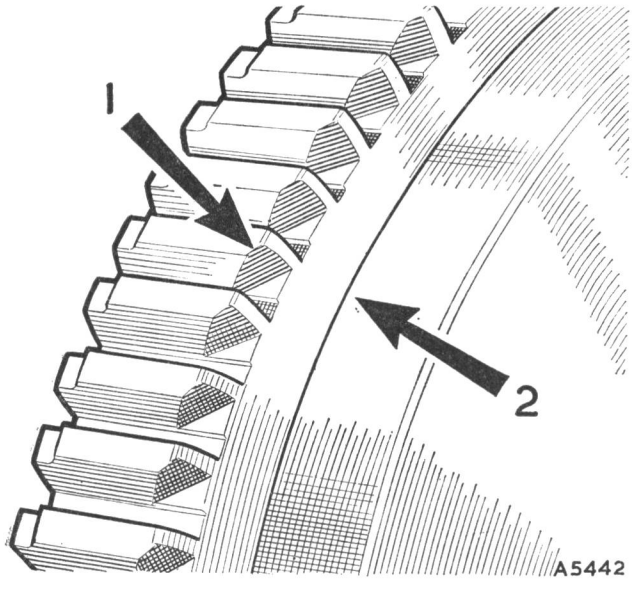


Fig. A.29

The starter ring, showing the lead on the teeth facing towards the flywheel register

This operation should be followed by natural cooling, when the 'shrink fit' will be permanently established and no further treatment required.

Section A.33

CYLINDER LINERS

Should the condition of the cylinder bores be such that they cannot be cleaned up to accept standard oversize pistons, dry cylinder liners can be fitted. This operation may be carried out by the use of specialized proprietary equipment or with a power press using pilot adaptors to the dimensions shown in Fig. A.30. The press must be capable of 3 tons (3048 kg.) pressure to fit new liners and 5 to 8 tons (5080 to 8128 kg.) to remove old liners.

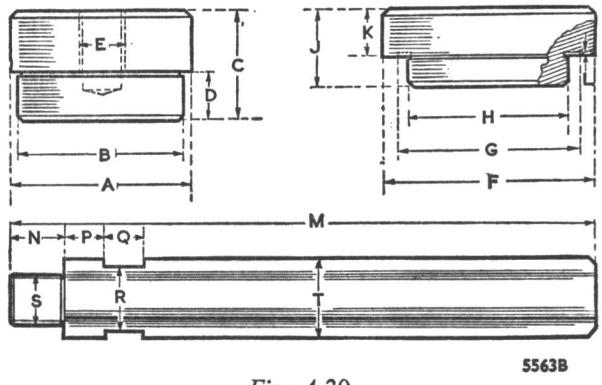


Fig. A.30

Cylinder liner pilots should be made to the above dimensions from case-hardening steel and case-hardened. The pilot extension should be made from 55-ton hardening and tempering steel, hardened in oil, and then tempered at 550° C. (1,020° F.)

Pressing-out pilot

A. $2\frac{37}{64}{}^{+\cdot005}_{-\cdot0}$ in. ($65{\cdot}48^{+\cdot127}_{-\cdot0}$ mm.).
B. $2{\cdot}465^{+\cdot0}_{-\cdot005}$ in. ($62{\cdot}61^{-\cdot0}_{+\cdot127}$ mm.).
C. $1\frac{3}{4}$ in. (44·45 mm.).
D. $\frac{3}{4}$ in. (19·05 mm.).
E. $\frac{3}{4}$ in. B.S.W. thread.

Pressing-in pilot

F. 3 in. (76·20 mm.).
G. $2\frac{5}{8}$ in. (66·68 mm.).
H. $2{\cdot}455^{+\cdot0}_{-\cdot050}$ in. ($62{\cdot}35^{+\cdot0}_{-\cdot127}$ mm.).
J. $1\frac{1}{4}$ in. (31·75 mm.).
K. $\frac{3}{4}$ in. (19·05 mm.).
L. ·015 in. (·38 mm.).

Pilot extension

M. $14\frac{1}{2}$ in. (36·83 cm.).
N. $\frac{7}{8}$ in. (22·22 mm.).
P. $\frac{5}{8}$ in. (15·87 mm.).
Q. $\frac{5}{8}$ in. (15·87 mm.).
R. 1 in. (25·4 mm.) flats.
S. $\frac{3}{4}$ in. B.S.W. thread.
T. $1\frac{1}{4}$ in. (31·75 mm.).

Remove the engine from the vehicle as detailed in Section A.18. Dismantle the engine and remove the cylinder head studs. If liners have not previously been fitted the bores must be machined and honed to the dimensions given in the table below.

Removing worn liners

Place the cylinder block face downwards on suitable wooden supports on the bed of the press, making sure

Engine type	*Liner Part No.*	*Machine bores of cylinder block to this dimension before fitting liner*	*Outisde diameter of liner*	*Interference fit of liner in cylinder block bore*	*Machine liner bore to this dimension after fitting*
'A' (848 c.c.)	2A 784	2·6035 to 2·604 in. (66·128 to 66·14 mm.)	2·606 to 2·60675 in. (66·19 to 66·21 mm.)	·002 to ·00325 in. (·05 to ·08 mm.)	2·477 to 2·4785 in. (62·915 to 62·954 mm.)

that there is sufficient space between the block and the bed of the press to allow the worn liner to pass down. Insert the pilot in the bottom of the liner and carefully press the liner from the bore.

Pressing in new liners

Thoroughly clean the inside of the bores and the outside of the liners. Stand the cylinder block upright on the bed of the press, insert the pilot guide in the top of the liner, and position the liner with its chamfered end in the top of the bore. Make certain that the liner is square with the top of the block and that the ram of the press is over the centre of the pilot. Press the liner into the bore.

Each liner must be machined to the dimension given after pressing into position.

Section A.34

ENGINE AND TRANSMISSION

The engine and transmission assembly can be removed and refitted through the bonnet aperture, provided a service pit is available or supports are placed under the front road wheels to raise the vehicle to a sufficient height for an operator to work beneath the front end.

Removing

Detach the earth lead from the battery and remove the bonnet from its hinges.

Unscrew the hexagon plug and remove the anti-rattle spring and plunger from the gear change extension casing.

Remove the two set screws securing the change speed lever retaining plate and pull the lever out of the casing from inside the car.

Unscrew the nuts and remove the two 'U' bolts securing the flexible coupling to the drive shaft sliding joint. Push the sliding joint onto the drive shaft to enable the coupling to be separated from and to clear the sliding joint when the engine is lifted. Take care not to damage the flexible rubber boot on the sliding joint. Disconnect the exhaust system from its fixing point on the transmission casing.

Disconnect the heater inlet and outlet hoses (if applicable).

Remove the carburetter as in Section A.4.

Disconnect the leads from the following: warning light switch on the cylinder block, coil, dynamo, distributor, earth lead on the clutch cover, and the cable from the starter motor.

Disconnect the sparking plug leads and remove the distributor cap.

Unscrew the sleeve nut to release the drive cable from the back of the speedometer. Remove the windshield washer bottle and bottle carrier from the wing valance of the instrument and release the cable from the clip on the bulkhead cross-member.

Release the exhaust pipe to manifold clamp and secure the pipe against the engine bulkhead.

Remove the two set screws securing the clutch slave cylinder to the flywheel housing, release the clutch cover tension spring, pull the push-rod from the slave cylinder, and secure the cylinder body against the engine bulkhead.

Disconnect the engine tie-rod from the cylinder block and swing the rod away from the engine.

Remove the valve rocker cover and cover gasket.

Remove the nuts from the second and fourth cylinder head studs on the forward side of the engine and fit two lifting eyes.

Take the weight of the engine with suitable lifting tackle, remove the two set screws securing each engine mounting to the sub-frame, and lift the engine from the vehicle.

When lifting the engine make certain that it does not foul the clutch slave cylinder, and ensure that the drive shaft sliding joints are held clear of the flexible couplings. Allow the engine tie-rod to pass between the clutch cover and lever. A millboard shield should also be inserted between the radiator and the wing valance to protect the radiator core from damage during the lifting operation.

Refitting

Refitting is a reversal of the removal procedure, with particular attention being given to the following points.

Make certain that the change speed lever is pulled up into the interior of the car before the engine is lowered into the engine compartment.

Keep the sliding joints pushed well onto the drive shaft splines while the flexible couplings are moved into position.

Refit the exhaust system, following the procedure given in Section A.5.

Section A.35

ENGINE MOUNTINGS

Removing

Left-hand mounting

Remove the radiator as in Section C.3.

Support the engine to take the weight off the mountings.

Remove the nuts securing the mounting bracket to the transmission casing, the two set screws, nuts, and spring washers securing the mounting to the sub-frame side-members, and withdraw the bracket and mounting assembly.

Right-hand mounting

Remove the clutch cover and engine mounting together as detailed in Section A.17. Unscrew three set screws to release the mounting from the cover.

Refitting

Refitting is a reversal of the removal procedure. Make certain that the paper gaskets are fitted between the left-hand mounting and the transmission casing and between the right-hand mounting and the clutch cover on all engines up to Engine No. 4354.

Section A.36

FIRST MOTION SHAFT OUTER RACE

Removing

To remove the outer race of the first motion shaft roller bearing from the flywheel housing remove the spring ring from its groove immediately above the outer race. Expand the bearing housing by immersing the flywheel housing in very hot water for several minutes. **Do not use other methods of heating the housing.** Overheating or the use of a flame can easily damage or destroy the flywheel housing.

Use Service tool 18G 617 A to remove the outer race from the housing. Dismantle the tool by removing the threaded centre holding pin, operating nut, washer, and outer sleeve. Insert the centre assembly of the tool into the race so that the lips of the collet register evenly under the lower edge of the race. Tighten the adjusting nut to expand the collet into the race. **Do not overtighten.** Refit the outer sleeve, washer, operating nut, and the holding pin. Hold the centre of the tool by the holding pin and tighten down the operating nut to withdraw the race from the housing.

This operation may also be carried out using Service tool 18G 617 B with the sleeve from the original Service tool 18G 617.

Refitting

When refitting an outer race expand the flywheel housing as previously described and position the race squarely in the mouth of the bore of the housing with the flywheel housing resting on a flat wooden surface, Using the driver portion of Service tool 18G 617 A, gently drift or press in the race until the top edge is just sufficiently clear of the ring groove to enable the spring ring to be refitted.

Refit the spring ring and lightly oil the race.

Section A.37

CRANKSHAFT PRIMARY GEAR

(Non-lubricated Bushes)

Later vehicles have bushes fitted to the crankshaft primary gear which require no lubrication, to reduce the possibility of oil leakage into the clutch. No oil feed is provided for these bushes from the crankshaft and no oil seal is fitted in the flywheel.

To remove the primary gear proceed as described in Section A.30.

When refitting, check the running clearance to the dimensions given in Fig. A.31 and adjust by fitting the correct thrust washer.

Section A.38

CRANKCASE CLOSED-CIRCUIT BREATHING

In order to conform to the air pollution regulations in certain countries crankcase fumes are directed into the induction manifold via the tappet chamber and a non-return valve on the manifold. A filter element is included on the tappet chamber cover and in the oil filler cap.

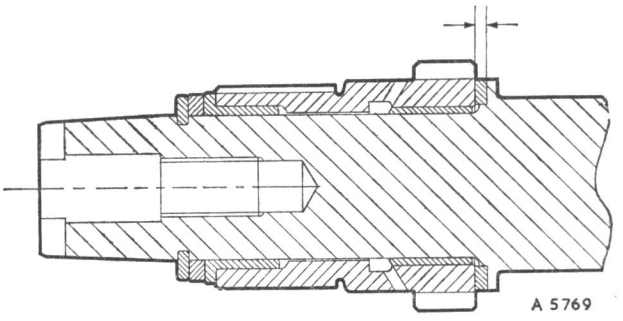


Fig. A.31

The correct running clearance is ·0035 *to* ·0065 *in.* (·0885 *to* ·1645 *mm.). Measure the gap indicated and fit the appropriate thrust washer as given below to obtain this clearance*

When gap is	*Use washer thickness*
·1175 to ·119 in. (2·875 to 3·025 mm.).	·112 to ·114 in. (2·848 to 2·898 mm.)
·119 to ·121 in. (3·025 to 3·076 mm.)	·114 to ·116 in. (2·898 to 2·949 mm.)
·121 to ·123 in. (3·076 to 3·127 mm.)	·116 to ·118 in. (2·949 to 3·000 mm.)
·123 to ·125 in. (3·127 to 3·18 mm.).	·118 to ·120 in. (3·000 to 3·051 mm.)

Servicing

(1) Remove the spring clip and extract the diaphragm and top spring.

(2) Clean the valve interior, particularly the control orifice, with methylated spirit.

(3) Clean the diaphragm, particularly the central needle and convolutions. Renew the diaphragm if it is damaged. Solvent such as trichlorethylene, cresol, acetone, or benzine must not be used as they will damage the diaphragm and valve seat.

(4) Clean the spring with solvent.

(5) Reassemble the valve, making certain the spring is located centrally under the diaphragm.

The above service should be carried out at the recommended mileage, and a new combined oil filler cap and filter assembly fitted at the same time.

Section A.39

FLYWHEEL AND CLUTCH

(Diaphragm Spring Clutch)

Removing

(1) Remove the engine as in Section A.34.

(2) Remove the nine clutch cover screws.

(3) Mark the pins and the cover to ensure refitting in their original positions.

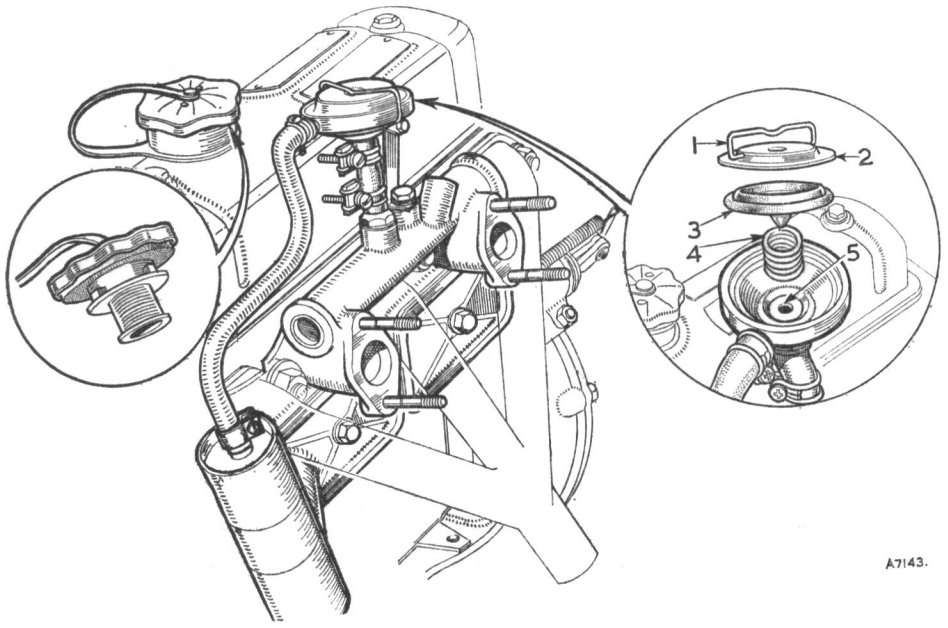


Fig. A.32

The crankcase closed-circuit breathing installation. (Inset) The oil filler cap filter and the breather control valve

1. Retaining clip.
2. Cover.
3. Diaphragm.
4. Spring.
5. Control orifice.

(4) Slacken the three clutch driving pins evenly to release the spring pressure. Replace the pins as they are removed one at a time with three $\frac{5}{16}$ in. UNF. × 2 in. studs to prevent the pressure plate moving out of alignment.

(5) Remove the cover and spring assembly.

(6) Bring Nos. 1 and 4 pistons to T.D.C. to prevent the primary gear 'C' washer falling and being wedged behind the flywheel. With the crankshaft in any other position this could happen and result in damage as the flywheel is withdrawn.

(7) Knock up the locking washer and slacken the flywheel retaining screw three or four threads.

(8) Use Service tool 18G 304 with adaptor set 18G 304 N (cadmium-plated) to remove the flywheel.

NOTE.—The black screws from set 18G 304 M must not be used on the diaphragm clutch.

(9) Screw the three adaptor screws into the flywheel and fit the plate of tool 18G 304 over the screws with the retaining nuts screwed on evenly to keep the plate parallel with the flywheel.

(10) Insert the short centre screw and withdraw the flywheel. Remove the tools immediately the flywheel is free.

(11) Unscrew and remove the flywheel retaining screw and keyed washer and withdraw the flywheel.

Inspection

(12) Inspect the cover for elongation of the driving pin holes.

(13) Inspect the driving pins for ridging and wear; fit three new pins if any are worn.

(14) Inspect the driving straps; fit three new ones if any are worn.

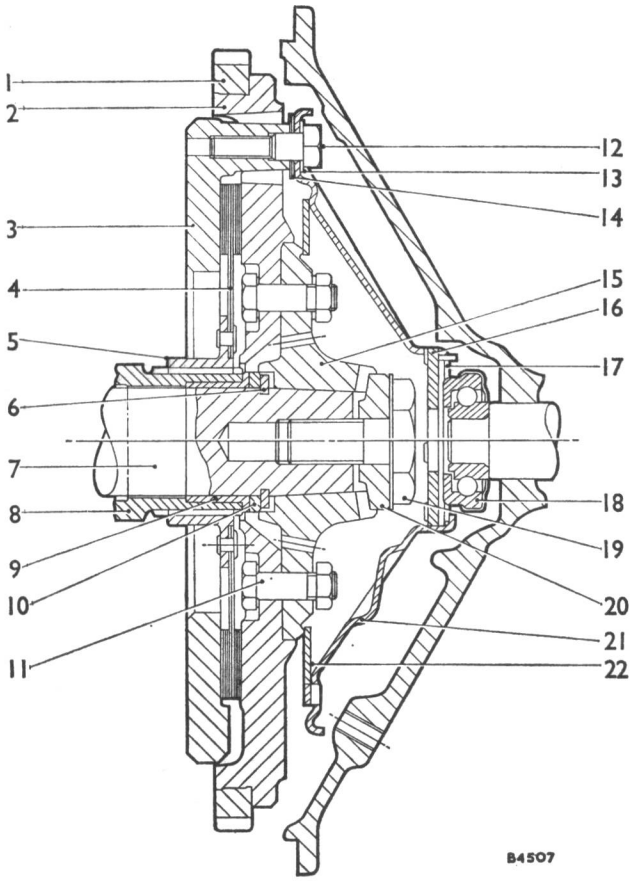


Fig. A.23

A section through the flywheel and diaphragm clutch assembly

1. Starter ring.
2. Flywheel.
3. Pressure plate.
4. Driven plate.
5. Driven plate hub.
6. Circlip.
7. Crankshaft.
8. Crankshaft primary gear.
9. Primary gear bearing.
10. Thrust washer.
11. Flywheel hub bolt.
12. Driving pin.
13. Lock washer.
14. Driving strap.
15. Flywheel hub.
16. Thrust plate.
17. Plate retaining spring.
18. Thrust bearing.
19. Flywheel screw.
20. Keyed washer.
21. Cover.
22. Diaphragm spring.

Refitting

Reverse the removal instructions and carry out the following:

(15) If the driving straps have been removed from the flywheel ensure that the spacing washers are fitted between the straps and the flywheel face.

(16) Make certain Nos. 1 and 4 pistons are at T.D.C. to prevent the primary gear 'C' washer falling out of position.

(17) Locate the cover and spring assembly with the driving pins in their original positions, tightening them a turn at a time by diametrical selection to a torque figure given in the **'GENERAL DATA'.**

(18) Tighten the flywheel retaining screw to the correct figure given in the **'GENERAL DATA'.**

Section A.40

TIMING COVER
(Modified timing cover and oil thrower)

A modified timing cover and oil thrower is fitted to later engines.

All modified components must be used together if required for earlier engines.

Note the following when replacing or refitting:

(1) The oil thrower must be fitted with the face marked 'F' away from the engine.

(2) Fit the oil seal from inside the cover, with Service tool 18G 134 and adaptor 18G 134 BD.

(3) When refitting the cover ensure that it is centralized on the crankshaft, using Service tool 18G 1044.

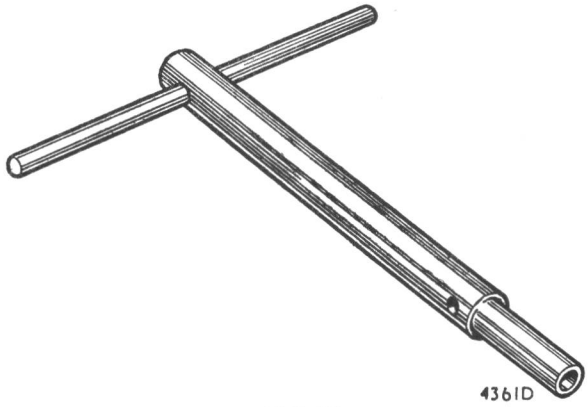
(4) Lightly lubricate the oil seal and refit the crankshaft pulley.

(*For* **'SERVICE TOOLS'** *see page A.26*)

SERVICE TOOLS

18G 27. Valve Seat Cutter Handle

Both the pilot and the handle are used with the finishing cutter, the glaze breaker, and the narrowing cutter.



18G 27

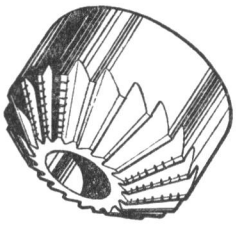
18G 167 D. Valve Seat Cutter Pilot

18G 167 D

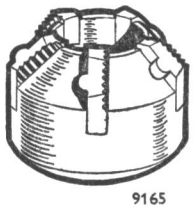
18G 167. Valve Seat Finishing Cutter

18G 167 A. Valve Seat Glaze Breaker

The use of these cutters will save lengthly and wasteful grinding in when the valve seats are pitted. Worn seats usually have a glass-hard surface, and the glaze breaker will prepare these seats for any cutting that may be necessary.



18G 167

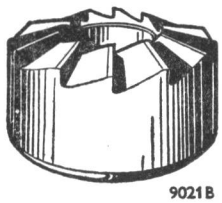


18G 167 A

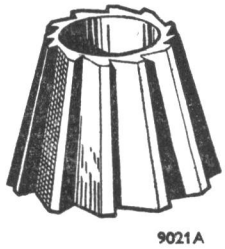
18G 167 B. Valve Seat Narrowing Cutter—Top

18G 167 C. Valve Seat Narrowing Cutter—Bottom

These narrowing cutters will enable the valve seats to be maintained at their original dimensions. See **'GENERAL DATA'.**



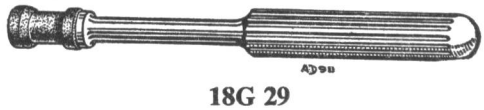
18G 167 B



18G 167 C

18G 29. Valve Suction Grinder

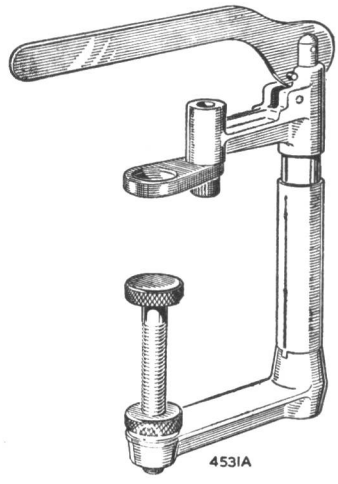
A metal handle complete with a detachable rubber suction pad (18G 29 A). An additional pad (18G 29 B) is required for use with this model.



18G 29

18G 45. Valve Spring Compressor

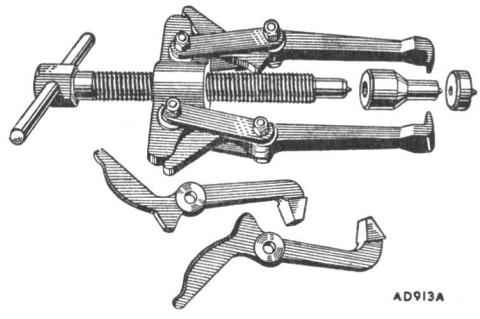
This tool is designed with a cam and lever action which is both positive and speedy. The adaptor ring is specially shaped to facilitate the removal and replacement of split collets. Screw adjustment is also provided.



18G 45

18G 2. Crankshaft Gear and Pulley Remover

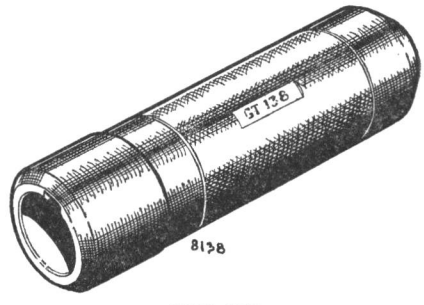
A multipurpose tool with alternative legs readily interchangeable: one pair with thin flat ends designed to remove the crankshaft gear, and the other pair with tapered ends suitable for pulley grooves.



18G 2

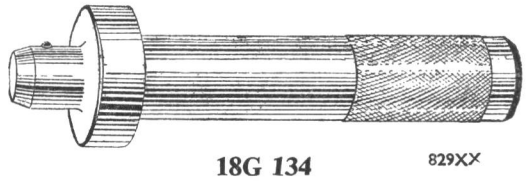
18G 138. Crankshaft Gear and Pulley Replacer

This tool will replace the crankshaft gear and ensure that the timing cover is located correctly. The felt oil seal and cover must be concentric with the crankshaft, thus safeguarding against oil leaks.



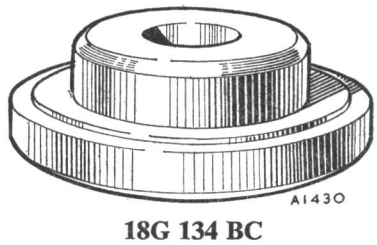
18G 138

18G 134. Bearing and Oil Seal Replacer (basic tool)



18G 134

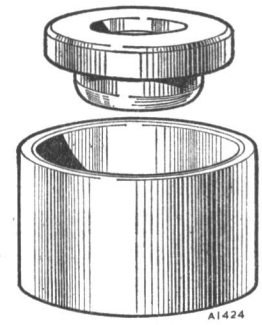
18G 134 BC. Crankshaft Primary Gear Oil Seal Replacer Adaptor



18G 134 BC

18G 134 BD. Timing Case Oil Seal Replacer Adaptor

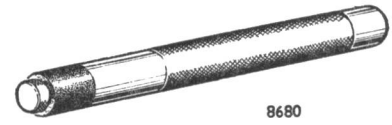
The fitting of the primary gear and timing case oil seals to their respective positions must be carried out with extreme care. Both the handle (Part No. 18G 134) and adaptors (Part Nos. 18G 134 BC and 18G 134 BD) must be used to ensure that the seals are fitted to their respective positions correctly and without damage.



18G 134 BD

18G 69. Oil Pump Release Valve Grinding-in Tool

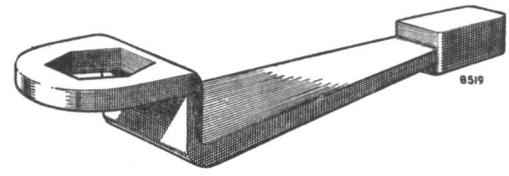
Designed to facilitate the removal and grinding in of the engine oil release valve. Tightening the set screw will expand the rubber plunger to ensure that the tool is a tight fit when inserted into the hollow oil release valve.



18G 69

18G 98. Shock Spanner

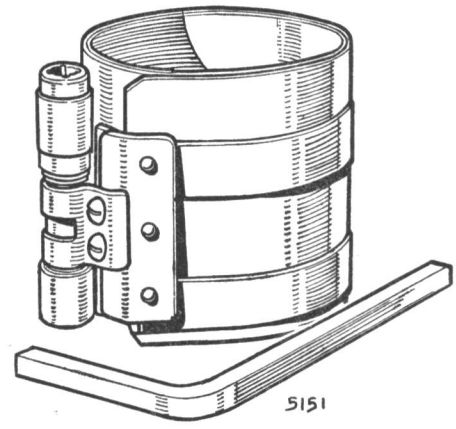
A shock-type spanner designed to remove the crankshaft pulley screw without having to lock the crankshaft by improvised means, which invariably damages the engine components.



18G 98

18G 55 A. Piston Ring Compressor

A clamping device to compress the piston rings, enabling the operator to push the piston assembly into the cylinder bore with minimum of pressure, thus avoiding damage to the piston and piston rings.

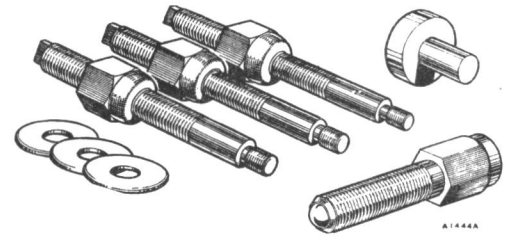


18G 55 A

18G 304 M. Flywheel and Clutch Remover Adaptor

These adaptors are for use with basic tool 18G 304 (shown at the end of Section K) to remove the flywheel from the crankshaft. The three identical screws must be screwed through the plate of this tool into the flywheel and the fourth screw used to replace the centre screw of the tool.

Do not use the three black adaptor screws on cars fitted with a diaphragm spring clutch.

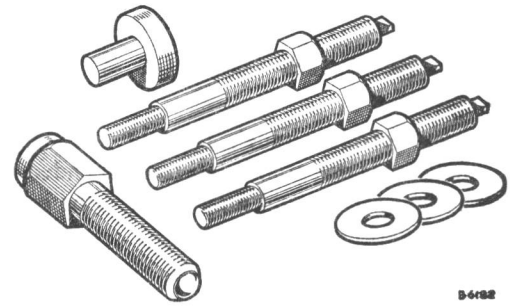


18G 304 M

18G 304 N. Flywheel and Clutch Remover Adaptors

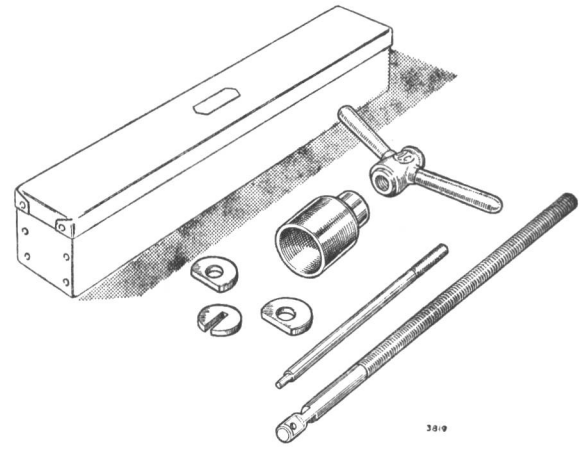
A set of adaptors which must be used when pulling a flywheel fitted with a diaphragm clutch. Use with tool 18G 304.

Do not use these adaptor screws on cars fitted with coil pressure spring clutch assemblies.



18G 304 N

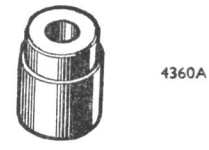
18G 124 A. Camshaft Liner Remover and Replacer (basic tool)



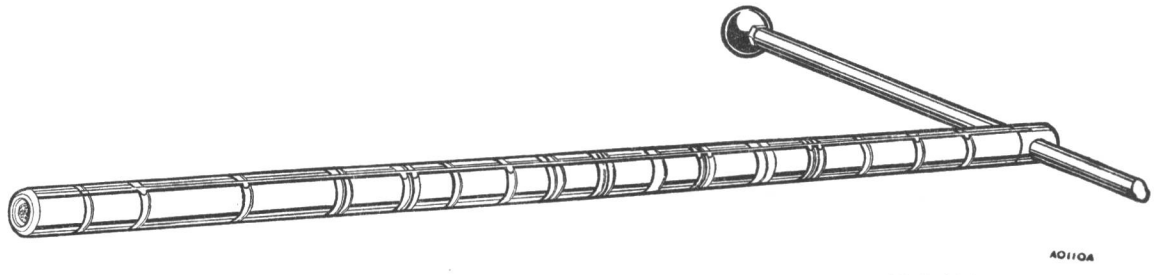
18G 124 A

18G 124 K. Camshaft Liner Remover Adaptor

With the aid of this tool and adaptor a camshaft liner can be removed and a new liner pulled into the cylinder block without the damage invariably associated with the use of improvised drifts.



18G 124 K



18G 123 A

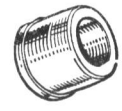
18G 123 A. Camshaft Liner Reamer (basic tool)

18G 123 AH. Camshaft Liner Reamer Pilot—Centre

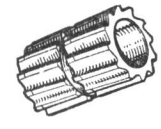
18G 123 AJ. Camshaft Liner Reamer Pilot—Rear

18G 123 AN. Camshaft Liner Reamer Cutter

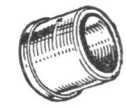
This equipment is essential when reconditioning cylinder blocks, otherwise camshaft liners cannot be reamed in line, and in consequence the clearance between the camshaft journal and the bearing will be incorrect.



18G 123 AJ



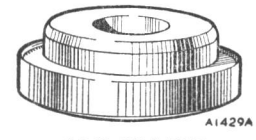
18G 123 AN



18G 123 AH

18G 134 BH. Flywheel and Front Hub Oil Seal Replacer Adaptor

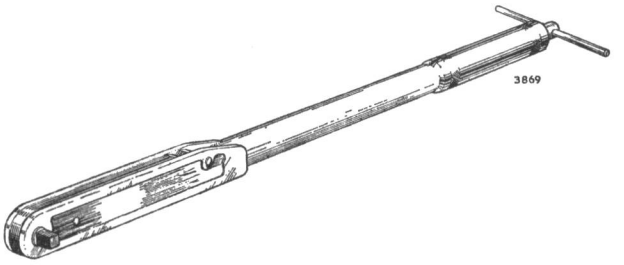
For the correct and easy replacement of the flywheel oil seal. Use in conjunction with handle (Part No. 18G 134).



18G 134 BH

18G 372. Torque Wrench—30 to 140 lb. ft. (4·15 to 19·4 kg. m.)

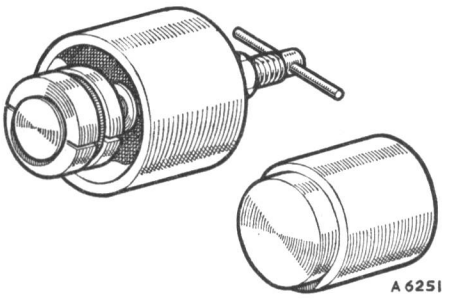
A universal torque wrench for use with standard sockets. This tool is essential if the recommended torque figure for cylinder head stud nuts is not to be exceeded.



18G 372

18G 617 A. Flywheel Housing Bearing (First Motion Shaft) Outer Race Remover/Replacer

This tool will remove and replace the outer race of the roller bearing without damage to the flywheel housing which occurs when improvized methods are used.

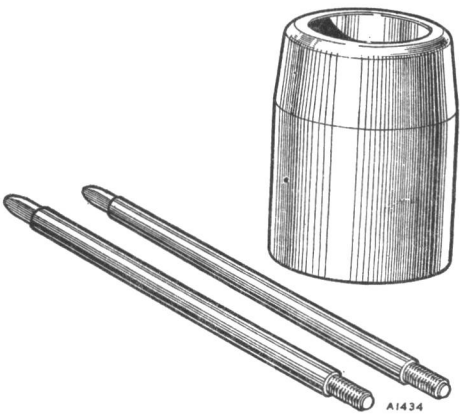


18G 617 A

18G 1043. Crankshaft Primary Gear Oil Seal Protector Sleeve

For use when fitting the flywheel housing to prevent the clutch splines on the crankshaft primary gear damaging the oil seal. This tool **must** be used for assembly when a red silicon rubber oil seal is fitted.

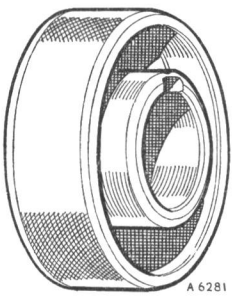
The earlier Protective Sleeve 18G 570 **must not** be used with the silicon rubber seal. The two pilot studs must be screwed into the two bottom tapped holes in the cylinder block.



18G 1043

18G 1044. Engine Front Cover Centralizer

For use when fitting the modified timing cover and oil thrower to centralize the cover on the crankshaft.



18G 1044

SECTION B

THE IGNITION SYSTEM

	Section
General description	
Capacitor	B.9
Contact breaker mechanism	B.5
Distributor	B.6
High-tension cables	B.3
Ignition adjustment	B.8
Sparking plugs	B.4
Testing the low-tension circuit	B.2
Timing the ignition	B.7
Uneven firing	B.1

GENERAL DESCRIPTION

The ignition system consists of two circuits—primary and secondary. The primary circuit includes the battery, the ignition switch, the primary or low-tension circuit of the coil, and the distributor contact breaker and capacitor. The secondary circuit includes the secondary or high-tension circuit of the coil, the distributor rotor and cover segments, the high-tension cables, and the sparking plugs.

The ignition coil, which is mounted on the right-hand side of the engine, consists of a soft-iron core around which is wound the primary and secondary windings. The coil carries at one end a centre high-tension terminal and two low-tension terminals marked 'SW' (switch) and 'CB' (contact breaker) respectively.

The ends of the primary winding are connected to the 'SW' and 'CB' terminals and the secondary windings to the 'CB' terminal and the high-tension terminal.

The distributor is mounted on the right-hand side of the engine and is driven by a shaft and helical gear from the camshaft. Automatic timing control of the distributor is controlled by a centrifugal mechanism and a vacuum-operated unit each operating entirely independently of each other. The centrifugal mechanism regulates the ignition advance according to engine speed, while the vacuum control varies the timing according to engine load. The combined effect of the two mechanisms gives added efficiency over the full operating range of the engine. A micrometer adjuster is provided to give a fine timing adjustment to allow for the engine condition and the grade of fuel used.

A keyed moulded rotor with a metal electrode is mounted on top of the cam. Attached to the distributor body above the centrifugal advance mechanism is a contact breaker plate carrying the contact breaker points and a capacitor connected in parallel. A cover is fitted over the distributor body and retained by two spring clips attached to the body.

Inside the cover is a centre electrode and spring-loaded carbon brush which makes contact with the rotor electrode. The brush is of composite construction, the top portion being made of a resistive compound, while the lower portion is made of softer carbon to prevent wear of the rotor electrode. Under no circumstances must a short, non-resistive brush be used to replace this long, resistive type. A measure of radio interference suppression is given by this brush.

Spaced circumferentially around the distributor cap are the sparking plug high-tension cable segments.

The distributor is secured in position on the cylinder block by a clamp plate.

The sparking plugs are located on the right-hand side of the engine and have a 14-mm. thread with a $\frac{3}{4}$-in. reach.

When the ignition is switched on, the current from the battery flows through the primary circuit and a magnetic field is built up around the core of the coil. When the contact breaker points are opened by rotation of the distributor cam the current flow is interrupted, causing a high voltage to be induced in the secondary winding of the coil by the sudden collapse and consequent change in the magnetic field. The high-tension current thus generated in the secondary winding of the coil is conveyed by the coil high-tension cable to the centre terminal of the distributor cover. From here the current passes through the carbon brush to the rotor electrode, and is distributed to the segments and thence to the sparking plugs via the high-tension cables.

Section B.1

UNEVEN FIRING

To test with sparking plugs in position

(1) Start the engine and set it to run at a fairly fast idling speed.

(2) Short-circuit each plug in turn by placing a hammer head or the blade of a screwdriver with a wooden or insulated handle between the terminal and the cylinder head. No difference in the engine performance will be noted when short-circuiting the plug in the defective cylinder. Shorting the other plugs will make uneven running more pronounced.

(3) Having located the cylinder which is at fault, stop the engine and remove the cable from the terminal of the sparking plug. Restart the engine and hold the end of the cable about $\frac{5}{16}$ in. (4·8 mm.) from the cylinder head.

(4) If the sparking is strong and regular the fault probably lies in the sparking plug. Remove the plug, clean it, and adjust the gap to the correct setting, or alternatively fit a replacement plug. See Section B.4.

(5) If there is no spark, or if it is weak and irregular, examine the cable from the sparking plug to the distributor. After a long period of service the rubber insulation may be cracked or perished, in which case the cable should be renewed. Finally, examine the distributor moulded cap, wipe the inside and outside with a soft dry cloth, see that the carbon brush moves freely in its holder, and examine the moulding closely for signs of breakdown. After long service it may have become tracked, that is, a conducting path may have formed between two or more of the electrodes or between one of the electrodes and some part of the distributor in contact with the cap. Evidence of a tracked cap is shown by the presence of a thin black line in the places indicated. A replacement distributor cap must be fitted in place of one that has become tracked.

Section B.2

TESTING THE LOW-TENSION CIRCUIT

Testing in position

(1) Spring back the securing clips on the distributor and remove the moulded cap and rotor. If the

rotor is a tight fit it can be levered off carefully with a screwdriver.

(2) Check that the contacts are clean and free from pits, burns, oil, or grease. Turn the engine and check that the contacts are opening and closing correctly and that the clearance when the contacts are fully opened is between ·014 and ·016 in. (·36 and ·40 mm.). Correct the gap if necessary.

(3) Disconnect the cable at the contact breaker terminal 'CB' of the coil and at the low-tension terminal of the distributor and connect a test lamp between these terminals. If the lamp lights when the contacts close and goes out when the contacts open the low-tension circuit is in order.

Locating a fault

(1) Having determined, by testing as previously described, that the fault lies in the low-tension circuit, switch on the ignition and turn the engine until the contact breaker points are fully opened.

(2) Refer to the wiring diagram and check the circuit with a voltmeter (0–20 volts) as follows.

NOTE.—If the circuit is in order the reading on the voltmeter should be approximately 12 volts.

(3) *Battery to starter switch.* Connect a voltmeter between the starter terminal and a good earthing point. No reading indicates a damaged cable or loose connections.

(4) *Starter switch to control box terminal 'A'* (brown lead). Connect a voltmeter to the control box terminal 'A' and to earth. No reading indicates a damaged cable or loose connections.

(5) *Control box.* Connect a voltmeter to the control box terminal 'A1' and to earth. No reading indicates a broken or loose connection.

(6) *Control box terminal 'A1' and feed terminal of the lighting switch* (brown with blue lead). Connect a voltmeter to the feed terminal of the lighting switch and to earth. No reading indicates a damaged cable or loose connections.

(7) *Lighting switch feed terminal to terminal on ignition switch* (brown with blue). Connect a voltmeter to the ignition switch terminal and to earth. No reading indicates a damaged cable or loose connections.

(8) *Ignition switch.* Connect a voltmeter to the other ignition switch terminal and to earth. No reading indicates a fault in the ignition switch.

(9) *Ignition switch to fusebox terminal 'A3'* (white lead). Connect the voltmeter to the fusebox terminal 'A3' and to earth. No reading indicates a damaged cable or loose connections.

(10) *Fusebox terminal 'A3' to ignition coil terminal 'SW'* (white lead). Connect a voltmeter to the ignition coil terminal 'SW' and to earth. No reading indicates a damaged cable or loose connections.

(11) *Ignition coil.* Disconnect the cable from the 'CB' terminal of the ignition coil and connect a voltmeter to this terminal and to earth. No reading indicates a fault in the primary winding of the coil and a replacement coil must be fitted. If the correct reading is given, remake the connections to the coil terminal.

(12) *Ignition coil to distributor* (white with black lead). Disconnect the cable from the low-tension terminal on the distributor and connect the voltmeter to the end of this cable and to earth. No reading indicates a damaged cable or loose connections.

(13) *Contact breaker and capacitor.* Connect the voltmeter across the contact breaker points. No reading indicates a fault in the capacitor.

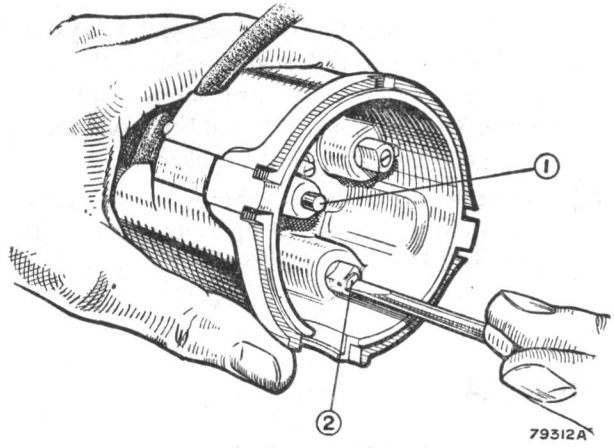


Fig. B.1

The method of connecting high-tension leads

1. Carbon brush. 2. Cable-securing screw.

Section B.3

HIGH-TENSION CABLES

(1) The high-tension cables must be examined carefully and any which have the insulation cracked, perished, or damaged in any way must be replaced by 7-mm. rubber-covered ignition cable.

(2) To fit the cable to the terminal of the ignition coil thread the knurled moulded terminal over the lead, bare the end of the cable for about ¼ in. (6 mm.), thread the wire through the brass washer removed from the original cable, and bend back the strands over the washer. Finally, screw into its terminal.

To make the connections to the terminals in the distributor moulded cap first remove the cap and slacken the screws on the inside of the moulding till they are clear of the cables. Cut the new cables off to the required length, fill the cable sockets in the moulding with Silicone grease, and push the cables completely home, watching in the process that the displaced surplus grease exudes evenly all

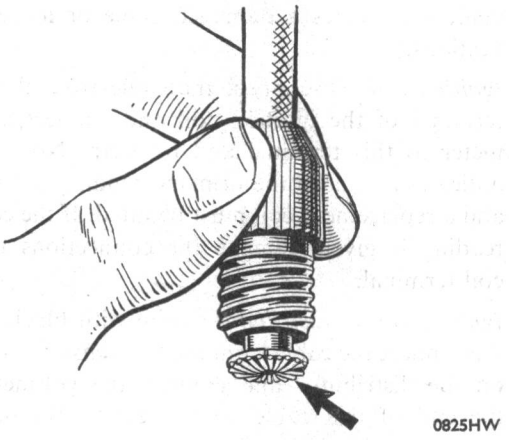


Fig. B.2

The correct method of fitting a high-tension cable to the ignition terminal nut

round the leads to form a perfect seal. Care should be taken to leave an adequate surplus on the surface of the cap at the lead entry points. Tighten the screws. They will pierce the rubber insulation and make good contact with the cable core.

(3) The cables from the distributor to the sparking plugs must be connected up in the correct firing order, which is, 1, 3, 4, 2.

Section B.4

SPARKING PLUGS

Service procedure

To maintain peak sparking plug performance plugs should be inspected, cleaned, and regapped at the periods stated in the Passport to Service. Under certain fuel and operating conditions, particularly extended slow-speed town driving, sparking plugs may have to be serviced at shorter intervals.

Disconnect the ignition cables from all sparking plugs. Loosen the sparking plugs about two turns counter-clockwise, using the proper size deep socket wrench.

Blow away the dirt from around the base of each plug. Remove the sparking plugs and place them in a suitable holder, preferably in the order they were in the engine.

Analysing service conditions

Examine the gaskets to see if the sparking plugs were properly installed. If the gaskets were excessively compressed, installed on dirty seats, or distorted, leakage has probably occurred during service which would tend to cause overheating of the sparking plugs. Gaskets properly installed will have flat, clean surfaces. Gaskets which are approximately one-half their original thickness will be satisfactory but thinner ones should be renewed.

Examine the firing ends of the sparking plugs, noting the type of the deposits and the degree of electrode erosion. Remember that if insufficient voltage is delivered to the sparking plug, no type of plug can fire the mixture in the cylinder properly.

Normal condition—look for powdery deposits ranging from brown to greyish tan. Electrodes may be worn slightly. These are signs of a sparking plug of the correct heat range used under normal conditions—that is, mixed periods of high-speed and low-speed driving. Cleaning and regapping of the sparking plugs is all that is required. Watch for white to yellowish powdery deposits. This usually indicates long periods of constant-speed driving or a lot of slow-speed city driving. These deposits have no effect on performance if the sparking plugs are cleaned thoroughly at the recommended intervals. Remember to 'wobble' the plug during abrasive blasting in a Champion service unit. Then file the sparking surfaces vigorously to expose bright, clean metal.

Oil fouling is usually indicated by wet, sludgy deposits traceable to excessive oil entering the combustion chamber through worn cylinders, rings, and pistons, excessive clearances between intake valve guides and stems, or worn and loose bearings, etc. Hotter-type sparking plugs may alleviate oil fouling temporarily, but in severe cases engine overhaul is called for.

Fuel fouling is usually indicated by dry, black, fluffy deposits which result from incomplete combustion. Too rich an air-fuel mixture, excessive use of the mixture control, or a faulty automatic choke can cause incomplete burning. In addition, a defective coil, contact breaker points, or ignition cable can reduce the voltage supplied to the sparking plug and cause misfiring. Sticking valves may also be the cause. Excessive idling, slow speeds, or stop-and-go driving can also keep the plug temperatures so low that normal combustion deposits are not burned off. In the latter case hotter-type plugs may be installed.

Burned or overheated sparking plugs are usually identified by a white, burned, or blistered insulator nose and badly eroded electrodes. Inefficient engine cooling and improper ignition timing can cause general overheating. Severe service, such as sustained high speed

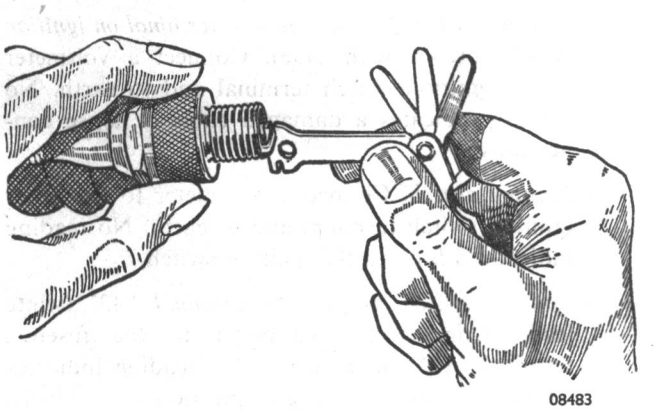


Fig. B.3

Reset the gap, using a Champion special gap setting tool shown above

and heavy loads, can also produce abnormally high temperatures in the combustion chamber which necessitate use of colder-type sparking plugs.

File the sparking surfaces of the electrodes by means of a point file. If necessary, open the gaps slightly and file vigorously enough to obtain bright, clean, parallel surfaces. For best results hold the plug in a vice.

Reset the gaps, using the bending fixture of the Champion gap tool. Do not apply pressure on the centre electrode as insulator fracture may result. Use the bending fixture to obtain parallel sparking surfaces for maximum gap life.

Visually inspect all sparking plugs for cracked or chipped insulators. Discard all plugs with insulator fractures.

Test the sparking ability of a used spark plug on a comparator.

Clean the threads by means of a hand or power-driven wire brush. If the latter type is used wire size should not exceed ·005 in. diameter. Do not wire-brush the insulator or the electrodes.

Clean the gasket seats on the cylinder head before installing sparking plugs to ensure proper seating of the sparking plug gaskets. Then, using a new gasket, screw in each plug by hand finger-tight.

NOTE.—If the sparking plug cannot be seated on its gasket by hand clean out the cylinder head threads with a clean-out tap or with another used sparking plug having three or four vertical flutes filed in its threads.

Finally, tighten the sparking plugs to the following values (pounds feet [kg. cm.]).

Size	*C.I. head*	*Alum. head*	*Turns*
14 mm.	30 (4·15)	27 (3·73)	½

The number of turns listed approximate to the proper torque values and should be used if a torque wrench is not available or cannot be used because of limited accessibility.

Connect the H.T. terminals after the plugs are installed.

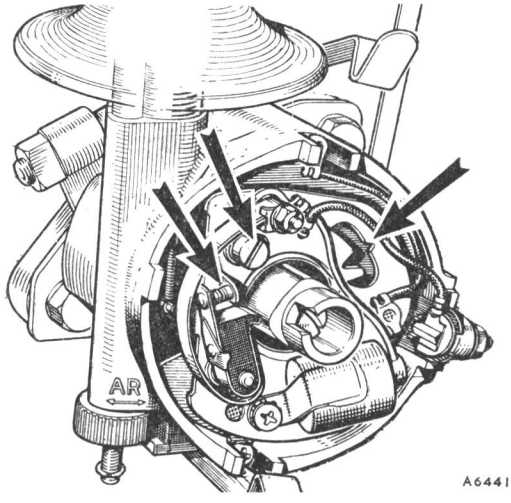


Fig. B.4

The distributor with the moulded cap and rotor arm removed, showing the contact breaker mechanism

Standard gap setting

The sparking plug gap settings recommended and listed under **'GENERAL DATA'** have been found to give the best overall performance under all service conditions. They are based on extensive dynamometer testing and experience on the road and are generally a compromise between the wide gaps necessary for best idling performance and the small gaps required for the best high-speed performance.

All plugs should be reset to the specified gap by bending the side electrode only, using the special tool available from the Champion Sparking Plug Company.

Section B.5

CONTACT BREAKER MECHANISM

Check the contact breaker at the periods stated in the Passport to Service as follows:

(1) Remove the distributor cap, taking care not to disturb the seals of water-repellent Silicone grease at the points of entry of the ignition leads into the cap. Adequate sealing is vital, since otherwise water may in extreme circumstances penetrate into the cap down the outside of the leads and cause ignition failure.

Later cars are equipped with waterproof rubber covers on the distributor cap and leads and the use of Silicone grease is not necessary.

(2) Turn the engine until the contact breaker points are fully opened and check the gap with a gauge having a thickness of from ·014 to ·016 in. (·36 to ·40 mm.). If the gap is correct the gauge should be a sliding fit. Do not alter the setting unless the gap varies considerably from the gauge thickness.

To adjust the setting keep the engine in the position which gives maximum opening of the contacts and then slacken the two screws securing the fixed contact plate. Adjust the position of the plate until the gap is set to the thickness of the gauge and then tighten the two locking screws.

Remember that the cam only keeps the contact points fully open over a very small angle and that care must be taken to ensure that the points are in the fully open position.

(3) If the contacts are dirty or pitted they must be cleaned by polishing them with a fine carborundum stone and afterwards wiping them with a fuel-moistened cloth. The moving contact can be removed from its mounting in order to assist cleaning. Check and adjust the contact breaker setting after cleaning the contacts.

(4) Check that the moving arm moves freely on its pivot. If it is sluggish remove the moving arm and polish the pivot pin with a strip of fine emery-cloth. Afterwards clean off all trace of emery dust and apply a spot of clean engine oil to the top of the pivot.

The contact breaker spring tension should be between 20 and 24 oz. (567 and 680 gm.) measured at the contacts.

(5) Check the Silicone grease water seal (if applicable) where the ignition leads enter the distributor cap, and renew if necessary.

Section B.6

DISTRIBUTOR

Removing

(1) The distributor can be removed and replaced without interfering with the ignition timing provided the clamp plate pinch-bolt is not disturbed.

(2) To facilitate the replacement of the distributor turn the engine over until the rotor arm is pointing to the segment in the cover for No. 1 cylinder plug lead to provide a datum for replacement. Also, ascertain the approximate position of the vacuum unit in order to facilitate the connection of the vacuum pipe on replacement.

(3) Remove the distributor cover and disconnect the low-tension lead from the terminal on the distributor. Disconnect the suction advance pipe at the union on the distributor.

(4) Extract the two bolts securing the distributor clamp plate to the distributor housing and withdraw the distributor.

Dismantling

The contact breaker plate may be removed as an assembly to give access to the centrifugal weights without completely dismantling the distributor. To do this first remove the rotor arm and then withdraw the slotted nylon low-tension terminal insulator from the distributor body.

Take out the two screws which secure the plate assembly to the distributor body, ease up the plate, and unhook the flexible actuating link connected to the contact breaker plate.

The following procedure is necessary if the distributor is to be completely stripped. Before dismantling, make a careful note of the positions in which the various components are fitted in order that they may be replaced correctly.

(1) Spring back the clips and remove the moulded cap.

(2) Lift the rotor off the top of the spindle. If it is a tight fit it must be levered off carefully with a screwdriver.

(3) Remove the nut and washer from the moving contact anchor pin. Withdraw the insulating sleeve from the capacity lead and low-tension lead connectors, noting the order in which they are fitted. Lift the moving contact from the pivot pin and remove the large insulating washer from the anchor pin.

(4) Take out the screw and spring and flat washers securing the fixed contact plate and remove the plate.

(5) Take out the securing screw and remove the capacitor.

(6) Extract the two screws securing the base plate to the distributor body, noting that one also secures the earthing lead, and lift out the base plate.

Unhook the flexible actuating link connecting the diaphragm in the vacuum unit with the moving contact breaker plate.

IMPORTANT.—Note the relative positions of the rotor arm drive slot in the cam spindle and the offset drive dog at the driving end of the spindle to ensure that the timing is not 180° out when the cam spindle is engaged with the centrifugal weights during assembly.

(7) Take out the cam retaining screw and remove the cam spindle.

(8) Take out the centrifugal weights. These may be lifted out as two assemblies, each complete with a spring and spring toggle (when fitted).

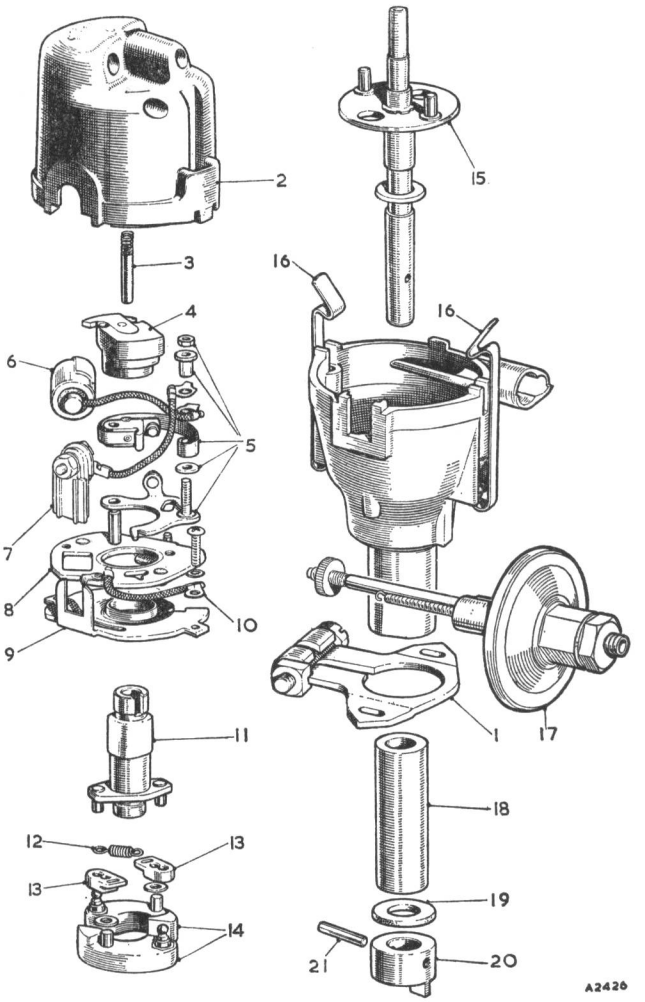


Fig. B.5

The components of the DM2P4 distributor

1. Clamping plate.
2. Moulded cap.
3. Brush and spring.
4. Rotor arm.
5. Contacts (set).
6. Capacitor.
7. Terminal and lead (low-tension).
8. Moving contact breaker plate.
9. Contact breaker base plate.
10. Earth lead.
11. Cam.
12. Automatic advance springs.
13. Toggles.
14. Weight assembly.
15. Shaft and action plate.
16. Cap-retaining clips.
17. Vacuum unit.
18. Bush.
19. Thrust washer.
20. Driving dog.
21. Taper pin.

(9) To release the suction advance unit remove the circlip, adjusting nut, and spring. Withdraw the unit. Take care not to lose the adjusting nut lock spring clip.

(10) To release the spindle from the body drive out the parallel driving pin passing through the collar of the driving tongue member at the lower end of the spindle.

(11) Clean the distributor cover and examine it for signs of cracks and evidence of 'tracking', i.e. a conducting path may have formed between adjacent segments. This is indicated by a thin black line between the segments; when this has occurred the cover should be renewed.

(12) Ensure that the carbon brush moves freely in the distributor cover.

(13) Examine the attachment of the metal electrode to the rotor moulding. If slack or abnormally burned, renew the rotor.

(14) The contact face of the contact breaker points should present a clean, greyish, frosted appearance. If burned or blackened, renew the contact set or polish the contact face of each point with a fine oil-stone, working with a rotary motion. Care should be taken to maintain the face of the points flat and square, so that when reassembled full contact is obtained. Clean the points thoroughly in fuel.

(15) Check that the movable contact arm is free on its pivot without slackness.

(16) Check the centrifugal timing control balance weights and pivot pins for wear, and renew the cam assembly or weights if necessary.

(17) The cam assembly should be a free sliding fit on the driving shaft. If the clearance is excessive, or the cam face is worn, renew the cam assembly or shaft as necessary.

(18) Check the fit of the shaft in the body bearing bush. If slack, renew the bush and shaft as necessary. To renew the bush, proceed as follows.

Press out the old bush. The new bush should be allowed to stand completely immersed in thin engine oil for 24 hours, or alternatively for two hours in oil which has been heated to 100° C. (212° F.), before pressing it into the distributor body.

Reassembling

Reassembly is a direct reversal of the dismantling procedure, although careful attention must be given to the following points:

(1) As they are assembled, the components of the automatic advance mechanism, the distributor shaft, and the portion of the shaft on which the cam fits must be lubricated with thin, clean engine oil.

(2) Turn the vacuum control adjusting nut until it is in the half-way position when replacing the control unit.

(3) When engaging the cam driving pins with the centrifugal weights make sure that they are in the original position. When seen from above, the small offset of the driving dog must be on the right, and the driving slot for the rotor arm must be in the six o'clock position.

(4) Adjust the contact breaker to give a maximum opening of ·014 to ·016 in. (·36 to ·40 mm.).

(5) Check the oil sealing ring on the mounting shank and fit a new seal if necessary (later models only).

Refitting

Carefully insert the distributor into its housing to avoid damage to the mounting shank oil seal (if fitted). Engage the driving dog lug with the slot in the driving spindle (both of which are offset) by slowly rotating the rotor arm. Turn the distributor body to align the clamping plate holes with those in the housing. The remainder of the assembling is now in the reverse order to that of removal.

Provided that the crankshaft has not been turned, the rotor arm will be opposite the segment for No. 1 plug lead. The high-tension leads can then be replaced on their respective plug terminals in the order of firing, i.e. 1, 3, 4, 2, remembering that the distributor rotation is anti-clockwise when viewed from above.

Normal ignition adjustment is given in Section B.8.

NOTE.—If the clamping plate has been removed, or even slackened, resulting in lost timing, the procedure given in Section B.7 should be undertaken to reset the distributor.

Renew the coating of Silicone grease where the high-tension leads enter the distributor head.

Section B.7

TIMING THE IGNITION

Where the ignition timing has been lost the following procedure should be undertaken to reset the distributor to its correct firing position:

(1) Remove the distributor and make quite certain that the distributor driving spindle has been refitted correctly as in Section A.16.

(2) Turn the crankshaft in the direction of rotation and watch the valves of No. 4 cylinder. When the valves are 'rocking' (i.e. exhaust just closing and the inlet just opening) on No. 4 cylinder, then No. 1 piston is approximately at T.D.C. on its compression stroke. If the crankshaft is now rotated until the '1/4' mark on the flywheel is in line with the pointer in the aperture on the clutch cover (see Fig. B.7) the piston is exactly at T.D.C. Turn the crankshaft from this position until the pointer indicates the correct setting.

In countries where the engine is required to operate on regular grade fuels of 90 octane and below, an alternative distributor is fitted, and can be identified by the letters 'Fa' included in the engine serial number. The static ignition timing for both types of distributor is given in **'GENERAL DATA'.**

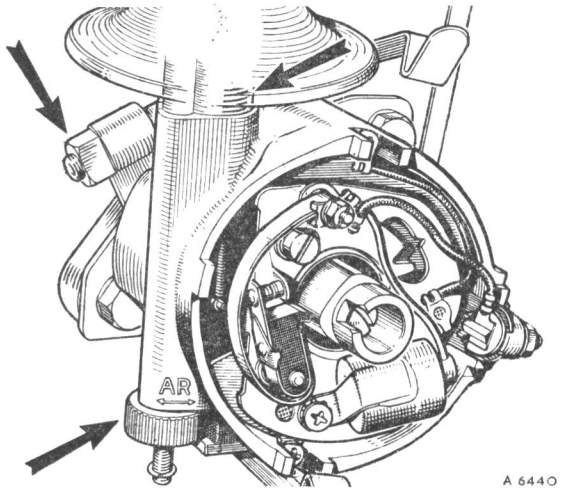


Fig. B.6

The distributor clamp plate pinch-bolt and vernier scale. The lower arrow indicates the ignition firing point adjusting nut

(3) Set the contact breaker points to ·014 to ·016 in. (·36 to ·40 mm.) when in their position of maximum opening. Carefully insert the distributor into its housing to avoid damage to the mounting shank oil seal (if fitted). Engage the driving dog lug with the slot in the driving spindle (both of which are offset) by slowly rotating the rotor arm.

(4) Screw in the two set screws to secure the distributor clamp to the distributor housing. It is essential to tighten up the clamp plate pinch-bolt to the correct torque tightness (see **'GENERAL DATA'**) in order to ensure correct alignment before tightening the set screws down in the centre of the elongated holes of the clamp plate.

(5) To obtain an accurate setting the electrical method should be used to determine the actual position at which the points just break, and the following procedure should be adopted.

Slacken the clamp pinch-bolt and rotate the distributor body in an anti-clockwise direction until the points are fully closed.

With the low-tension lead connected to the distributor, turn on the ignition switch and connect a 12-volt lamp in parallel with the contact breaker points (i.e. one lead from the distributor low-tension terminal and the other to earth) and rotate the distributor clockwise until the lamp lights, indicating that the points have just opened. Secure the distributor body in this position by tightening up the clamp plate pinch-bolt.

Finally, check that the rotor arm is opposite the correct segment in the distributor cap for the No. 1 cylinder.

Reconnect the suction advance pipe.

Should a stroboscopic lamp be used, care must be taken that with the engine running the engine speed is low enough to ensure that the centrifugal weights are not in operation. When the vacuum advance take-off is direct from the induction manifold this should be disconnected before attempting the timing check, otherwise the engine timing will be set retarded.

Section B.8

IGNITION ADJUSTMENT

Adjustment is provided for the ignition point to enable the best setting to be attained for varying fuels. The adjustment nut is indicated by the lower arrow in Fig. B.6; turning the nut clockwise retards, and anti-clockwise advances, the ignition. Each graduation on the adjusting spindle barrel represents approximately 5° timing movement and is equal to 55 clicks on the knurled adjuster nut. The range of adjustment provided by this micrometer adjuster is normally ample to deal with any variation encountered.

Do not disturb the pinch-bolt unless absolutely necessary. Should the ignition timing have been lost, retiming should be undertaken as given in Section B.7.

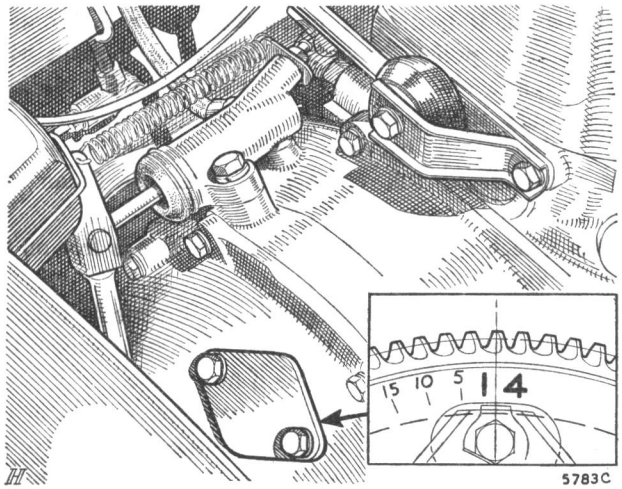


Fig. B.7

The timing marks on the flywheel, and the indicator, may be seen with the aid of a mirror after removing the inspection plate on the clutch cover. T.D.C. position is indicated by the mark '1/4', *and, in addition,* 5°, 10°, *and* 15° *B.T.D.C. marks are also provided*

Section B.9

CAPACITOR

The best method of testing the capacitor is by substitution. Disconnect the original capacitor and connect a new one between the low-tension terminal of the distributor and earth.

Should a new capacitor be necessary, it is advisable to fit a complete capacitor and bracket, but should a capacitor only be available, use a hot iron to soften the solder securing the defective capacitor to the bracket. Care must be taken not to overheat the new capacitor when soldering it in position. The capacity of the capacitor is ·2 microfarad.

SECTION C

THE COOLING SYSTEM

	Section
General description	
Draining and flushing the system	C.2
Fan belt	C.4
Thermostat	C.6
Radiator	C.3
Filler cap	C.1
Water pump	C.5

GENERAL DESCRIPTION

The cooling system is pressurized, and the water circulation is assisted by a pump attached to the front of the engine and driven by a belt from the crankshaft. The water circulates from the base of the radiator and passes around the cylinders and cylinder head, reaching the header tank of the radiator core via the thermostat and the top water hose. From the header tank it passes down the radiator core to the base tank of the radiator. Air is blown through the radiator by a fan attached to the water pump pulley.

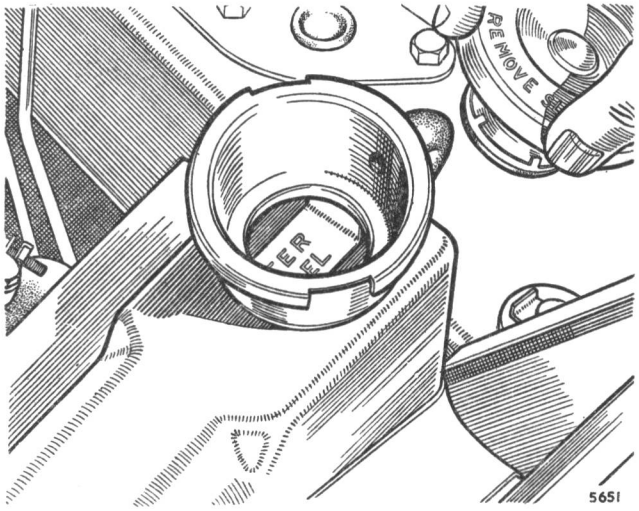


Fig. C.1

The filler cap of the sealed cooling system removed, showing the water level indicator

Section C.1

RADIATOR FILLER CAP

The cooling system is under appreciable pressure while the engine is hot after a run, and the radiator filler cap must be removed very carefully or left in position until the water has cooled.

If it is necessary to remove the filler cap when the engine is hot it is absolutely essential to remove it gradually, and the filler spout is provided with a specially shaped cam to enable this to be done easily.

Unscrew the cap slowly till the retaining tongues are felt to engage the small lobes on the end of the filler spout cam, and wait until the pressure in the radiator is fully released before finally removing the cap.

It is advisable to protect the hand against escaping steam when removing the cap while the system is warm.

Section C.2

DRAINING AND FLUSHING THE SYSTEM

Draining

Remove the radiator header tank filler cap.

Drain the system using the taps (or plugs if fitted) at the base of the radiator and at the rear of the cylinder block.

NOTE.—If Bluecol or other anti-freeze mixture is being used it should be drained into a suitable container and carefully preserved for replacement.

Flushing

To ensure sufficient circulation of the coolant and to reduce the formation of scale and sediment in the radiator the system whould be periodically flushed with clean running water, preferably before putting in anti-freeze in the autumn and again when taking it out in the spring. The water should be allowed to run through until it comes out clear from the drain tap.

Where furring is excessive the radiator should be removed as in Section C.2 and flushed through in the reverse way to the flow, i.e. turn the radiator upside-down and let the water flow in through the bottom hose connection and out through the top. The use of radiator reverse-flush adaptor 18G 187 is recommended for this purpose, used with 1 in. (25·4 mm.) diameter water hose.

Refilling

Close the drain tap(s) or refit the drain plug(s).

Ensure that the water hose clips are tightened.

Fill up the system through the filler in the radiator header tank until the water is up to the level indicator strip.

When possible, rain-water should be used for filling the system.

Avoid overfilling when anti-freeze is in use to prevent unnecessary loss on expansion.

Screw the filler cap firmly into position.

Only anti-freeze mixtures of the ethylene glycol or glycerine type should be employed.

Anti-freeze can remain in the cooling system for two years provided that the specific gravity of the coolant is checked periodically and anti-freeze added as required. Specialized equipment is necessary to check the specific

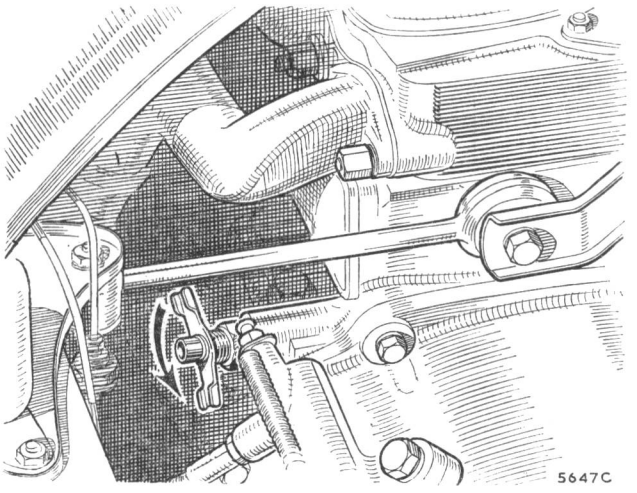


Fig. C.2

The cylinder block drain tap is on the left-hand side of the block at the rear end

gravity, which can be obtained from the anti-freeze manufacturer.

After the second winter, drain the system and flush-out. Refill with fresh water or the recommended anti-freeze solution.

Section C.3

RADIATOR

Removing

Remove the bonnet.

Drain the water from the system as in Section C.2.

One-piece cowling

Remove the cowling upper support bracket and withdraw the two bolts securing the cowling to the support bracket on the engine mounting.

Release the clips on the top and bottom water hoses. Detach the top hose from its connection and completely remove the bottom hose.

Remove the four screws securing the radiator to the cowling. Lift out both the radiator and cowling.

Two-piece cowling fitted from Car No. 3941

Remove the cowling upper support bracket.

Withdraw the two bolts securing the bottom support bracket to the engine mounting.

Release the clips and pull the top hose from its connection on the radiator and the bottom hose from the water pump.

Extract the six screws securing the radiator to the cowling and remove the top half of the cowling.

Manœuvre the bottom hose to the outside of the bottom half of the cowling and lift the radiator from the vehicle.

Refitting

Installation is a reversal of the removal procedure. Refer to Section C.2 before refilling.

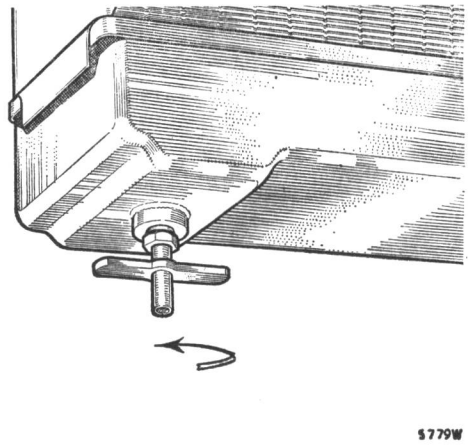


Fig. C.3

Access to the radiator drain tap is from beneath the car. Turn the tap anti-clockwise to open

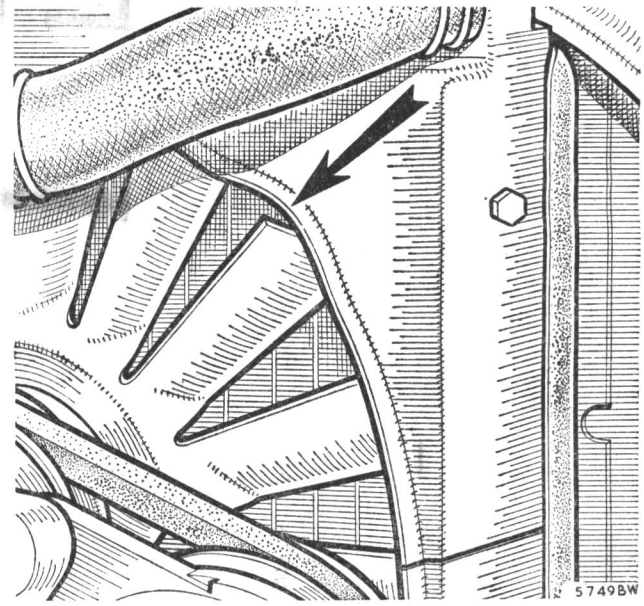


Fig. C.4

Turn the fan blades to the position indicated where the fan belt can be extracted through the recess provided in the radiator cowling

Section C.4

FAN BELT

Adjustment

Adjust the dynamo and fan belt tension by slackening the two dynamo pivot bolts, releasing the bolt on the slotted adjusting link, and pulling the dynamo bodily outwards until the belt tension is correct. Tighten up the bolts with the dynamo held in this position. A gentle hand-pull only must be exerted on the dynamo, otherwise the tension will be excessive and undue strain will be thrown on the dynamo bearings.

The belt should be sufficiently tight to prevent slip, yet it must be possible to move it laterally about 1 in. (2·54 cm.).

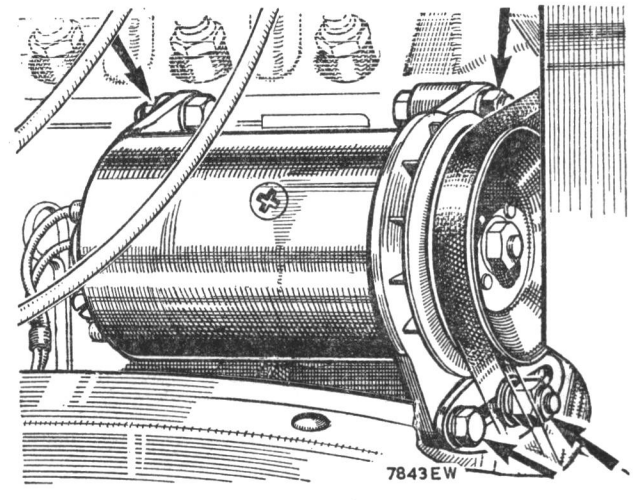


Fig. C.5

The four dynamo attachment points to be slackened for fan belt adjustment

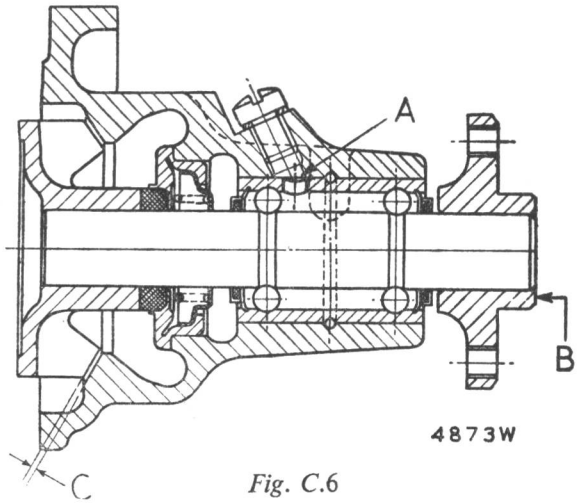


Fig. C.6

A section through the water pump showing the location of the components. When assembled, the hole (A) *in the bearing must coincide with the lubricating hole in the water pump and the face of the hub* (B) *must be flush with the end of the spindle. The clearance at* (C) *must be* ·020 *to* ·030 *in.* (·508 *to* ·762 *mm.*)

Removing

Slacken the dynamo pivot and adjusting link bolts. Lift the dynamo, release the belt from the crankshaft pulley, and remove the belt by manœuvring it between the fan blades and the radiator. Sufficient clearance has been provided to allow the belt to pass between the fan blades and the right-hand top of the cowling flange.

When removing the fan belt from a vehicle fitted with the later-type 16-bladed fan it is necessary to feed the belt between each individual blade tip and the cut-out in the cowling flange until the belt can be withdrawn.

Section C.5

WATER PUMP

The water pump is of the centrifugal impeller type mounted on a common spindle with the fan, and operating in a cast housing mounted on the front of the cylinder block. Water-sealing is effected by a spring-loaded carbon washer bearing upon a seating in the impeller housing. It is necessary to dismantle the pump and fan assembly to obtain access to the sealing gland. Removing, dismantling, and refitting instructions are given in the following paragraphs.

Removing

Drain the water from the cooling system and remove the radiator as in Section C.3.

Remove the hose from the water pump inlet connection and slacken the top clip of the thermostat by-pass hose, the dynamo mounting bolts, and the adjusting screw. Withdraw the four set screws securing the fan blades to the water pump hub and remove the blades, belt, and pulley.

Unscrew the four set screws securing the pump to the cylinder block and remove the pump complete with the by-pass hose.

Dismantling

Pull out the bearing locating wire through the hole in the top of the pump body.

Gently tap the spindle rearwards to release the combined spindle and bearing assembly, together with the seat and vane.

Withdraw the vane from the spindle with a suitable extractor and remove the pump seal assembly.

Should the bearing show signs of wear or damage, it must be replaced by a new bearing and spindle assembly; bearings alone are not serviced. The seal assembly should also be replaced with a new seal if wear or damage is apparent or if the pump is leaking.

Reassembling

Reassembly is a reversal of the dismantling procedure. Make certain that the hole in the bearing is lined up with the lubricating hole in the pump body before pressing the bearing and spindle into position.

Should the interference fit of the fan hub have been impaired when the hub was withdrawn from the spindle, a new hub **must** be fitted.

Lubrication

The pump must be lubricated very sparingly with the recommended grease at the intervals as stated in the Passport to Service.

Section C.6

THERMOSTAT

Removing

(1) Drain the cooling system (Section C.2.)

(2) Disconnect the top hose and remove the cowling upper support bracket.

(3) Remove the securing nuts and spring washers from the thermostat cover and the cover from its studs.

(4) Remove the paper joint washer and lift out the thermostat.

Testing

(5) Test the thermostat opening temperature by immersing it in water and raising the temperature of the water to the thermostat opening temperature as given under **'GENERAL DATA'.** If the thermostat valve fails to open or sticks in the fully open position, fit a new one; do not attempt to repair it.

Refitting

(6) Installation of the thermostat assembly is the reverse of the removal procedure. Fit a new joint washer if the existing one is damaged.

(7) A wax-element-type thermostat together with a modified thermostat water outlet cover is fitted to later vehicles.

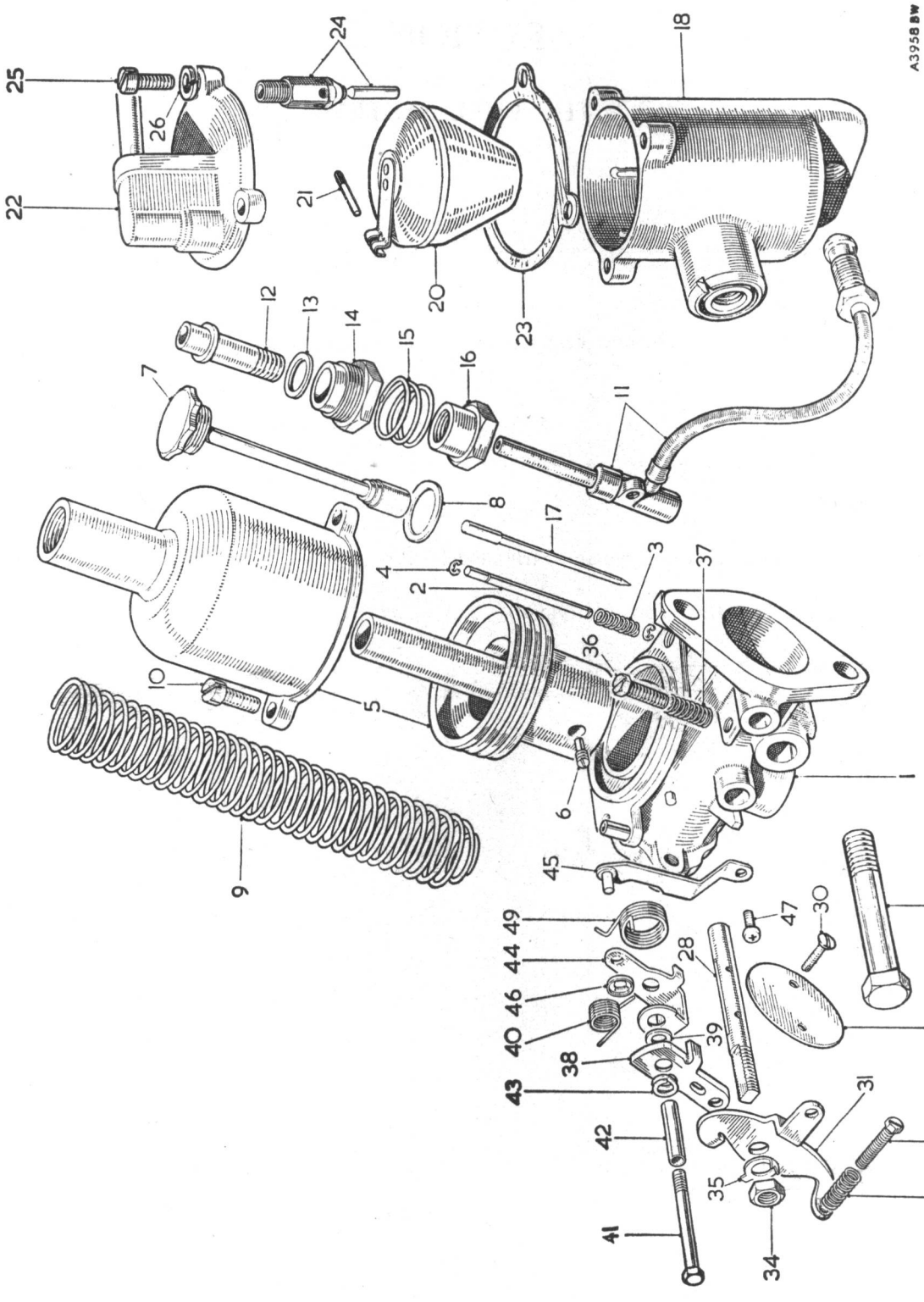
(8) When refitting this type of thermostat it is essential that the threaded stem faces upwards.

SECTION D

THE FUEL SYSTEM

	Section
Air cleaner	D.5
Air cleaner (impregnated element)	D.8
Carburetter	D.4
Induction and suction chamber heaters	D.6
Fuel pump	D.3
Fuel pump (Moke)	D.19
Fuel tank (Saloon)	D.1
Fuel tank (Traveller and Countryman—early models)	D.9
Fuel tank (Van, Traveller, and Countryman)	D.7
Fuel tank (Moke)	D.20
Gauge unit	D.2
Nylon float adjustment	D.18
SP-type fuel pump	
Assembling	D.15
Description	D.10
Dismantling	D.13
Inspecting	D.14
Mounting	D.12
Operation	D.11
Testing	D.16
The AUF 201 fuel pump	D.17

THE CARBURETTER COMPONENTS



KEY TO THE CARBURETTER COMPONENTS

No.	*Description*
1.	Body.
2.	Piston lifting pin.
3.	Spring for pin.
4.	Circlip for pin.
5.	Suction chamber and piston assembly.
6.	Needle locking screw.
7.	Piston damper assembly.
8.	Washer for damper cap (fibre).
9.	Piston spring.
10.	Screw—suction chamber to body.
11.	Jet assembly.
12.	Jet bearing.
13.	Washer for jet bearing (brass).
14.	Lock screw for jet bearing.
15.	Lock spring.
16.	Jet adjusting screw.
17.	Jet needle.
18.	Float-chamber body.
20.	Float and lever assembly.
21.	Lever hinge pin.
22.	Float-chamber lid assembly.
23.	Washer for lid.
24.	Needle and seat assembly.
25.	Screw—float-chamber lid to body.
26.	Spring washer.
28.	Throttle spindle.
29.	Throttle disc.
30.	Screw—throttle disc.
31.	Throttle lever.
32.	Cam stop screw.
33.	Spring for stop screw.
34.	Throttle spindle nut.
35.	Tab washer for nut.
36.	Idling stop screw.
37.	Spring for stop screw.
38.	Cam lever.
39.	Washer.
40.	Cam lever spring.
41.	Cam lever pivot bolt.
42.	Pivot bolt tube.
43.	Spring washer.
44.	Pick-up lever assembly.
45.	Jet link.
46.	Jet link retaining clip.
47.	Jet link securing screw.
49.	Spring for pick-up lever.

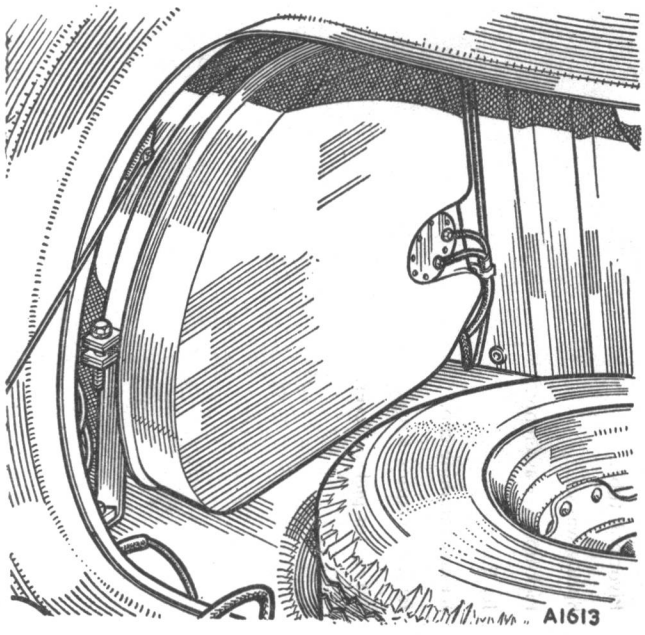


Fig. D.1

The fuel tank located on the left-hand side of the luggage compartment, showing the position of the tank gauge unit and the tank strap securing screw. The tank locating plate is shown in Fig. D.2

Section D.1

FUEL TANK

Removing

Disconnect the flexible fuel hose from the pump connection located on the inside of the left-hand rear sub-frame member and drain the fuel into a suitable container.

A fuel tank drain plug is fitted to later models and can be reached from beneath the rear of the vehicle with a tubular box spanner $\frac{7}{16}$ in. across the flats and 5 in. long. The plug operates on the same principle as a brake bleed screw, thus it is only necessary to unscrew it approximately three turns to release the fuel. Allow the fuel to flow down the drain tube clear of the exhaust pipe.

Remove the filler cap. Disconnect the lead from the fuel tank gauge unit and remove the securing bolt from the tank strap. Release the clip retaining the vent pipe to the rear of the seat panel and manœuvre the tank from the luggage compartment, at the same time drawing the fuel pipe and the vent pipe through the floor.

Note the locating plate fitted beneath the tank.

A modified fuel tank is fitted to later models incorporating a fuel drain tube. Where this drain tube is fitted the drain plug and tube must be removed before the tank can be withdrawn from the luggage compartment, and must not be refitted to the tank until the tank is repositioned in the vehicle.

Refitting

When refitting make sure that the vent pipe is pushed through the same hole in the floor as the wiring harness.

Secure the free end of the vent pipe with a rubber clip against the flexible fuel feed pipe clear of the petrol pump.

Refit the clip retaining the vent pipe to the seat panel, taking care not to distort the pipe.

Care must be taken on reassembly to ensure that the seal between the drain plug housing and the body is water-tight.

Refit the locating plate beneath the tank before the straps are fastened.

Section D.2

FUEL TANK GAUGE UNIT

Remove the earth lead from the battery terminal and disconnect the electrical lead from the fuel gauge unit.

Unscrew the six screws securing the gauge unit to the tank and withdraw the complete assembly, taking care not to strain or bend the float lever.

When replacing the gauge unit a new joint washer must be fitted and a suitable sealing compound employed to make a fuel-tight joint.

Section D.3

FUEL PUMP

Description

The type PD fuel pump is located on the left-hand member of the rear sub-frame and differs from previous designs in that the diaphragm is actuated magnetically through the medium of a hydrostatic as distinct from a direct mechanical connection. By this arrangement the lost motion between the volumetric displacement of the pump diaphragm and its centre plate by mechanical means is eliminated. The pumping diaphragm suffers very little flexure, and it is, therefore, possible to make use of a Terylene film diaphragm in place of the synthetic rubber material formerly employed.

Three pressings soldered to a central brass tube comprise the main structure of the pump. The brass tube houses a permanent magnet with two steel pole-pieces, a steel plunger separated from the magnet by an insulated distance piece, and a coil spring to impel the magnet and plunger downwards. The tube is completely filled with a light mineral oil and hermetically sealed by the upper and lower diaphragms. The contact breaker mechanism is mounted on a plate above the solenoid windings and is not serviced separately.

Operation

The following résumé of the PD fuel pump action is given for information only; the pump must not be dismantled.

When the pump is at rest the plunger assembly with the magnet and pole-pieces is at the bottom of its stroke; in this position the low pole-piece will attract the lower ear of the contact breaker rocker, and with the rocker

finger pressing upwards against the spring blade will ensure that the tungsten points are in contact. With the electric circuit completed the solenoid is energized, and the plunger, magnet, and pole-pieces are magnetically impelled upwards. The fluid contained in the tube is hermetically sealed and will therefore follow the plunger and displace the diaphragm upwards, causing a volumetric increase in the pumping space below the diaphragm and thereby drawing in fuel via the inlet valve.

As the plunger approaches the extremity of its upward stroke the upper pole-piece will attract the upper ear of the contact breaker rocker; the rocker finger will recede from the lower contact blade and allow the tungsten points to break contact. The electro-magnetic system will now become demagnetized, allowing the plunger and its associated parts to descend under the load of the feed spring, and so reverse the action of the diaphragm to expel fuel through the delivery valve. The pumping cycle is then repeated.

When the outlet valve is obstructed by the limited rate at which the engine will draw upon the maximum flow available some downward movement of the plunger under spring pressure will still take place. To prevent the plunger becoming hydraulically locked a recuperating valve is incorporated in the plunger, returning any excess fluid from the upper to the lower regions bounding the plunger.

Removing

Disconnect the leads from the terminals on the pump body. Pull the fuel lines from the inlet and outlet connections on the pump, at the same time draining the fuel into a suitable container.

Remove the two screws securing the mounting bracket to the sub-frame side-member to release the pump and pump bracket.

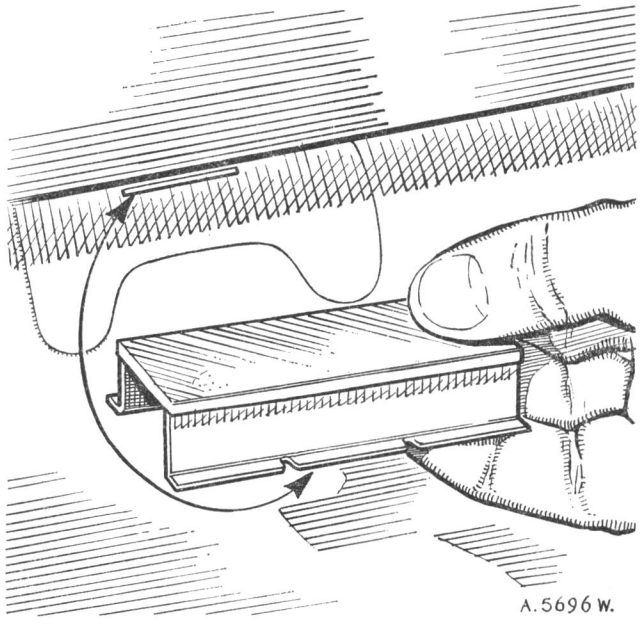


Fig. D.2

The tongue of the fuel tank locating plate must be secured in the slot in the luggage compartment floor

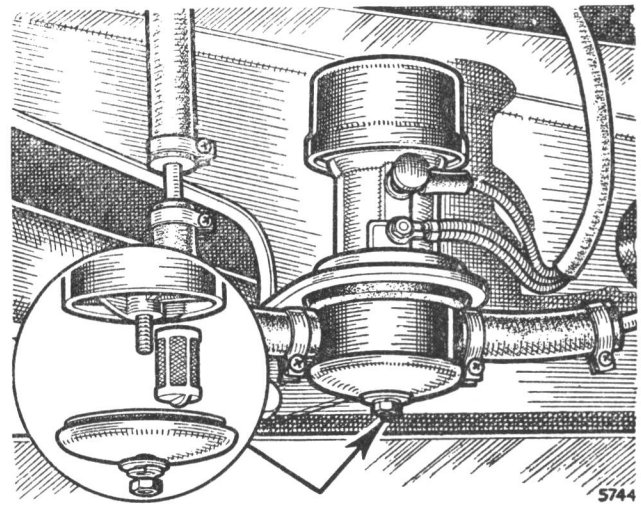


Fig. D.3

The electric fuel pump is located on the inside of the rear sub-frame left-hand side-member. The inset shows the method of access to the filter

Servicing

Owing to the hermetic sealing employed in the main construction of the pump, only the component parts listed in the caption to the illustration (Fig. D.4) are accessible and serviced separately. Should a breakdown occur and the pump fail to respond to the following attentions, a replacement pump must be fitted.

The petrol pump is often blamed for trouble associated with fuel starvation, but this may be due to a variety of causes. Therefore, before renewing the pump, first check the following points:

(1) Venting of petrol tank.
(2) Dirt or water in the petrol system.
(3) Sticking carburetter piston or float needle valve.
(4) Fault in petrol pump connections.

Cleaning the filter

Blockage of the filter will result in gradual falling off in maximum delivery of the pump, and will be detected by a tendency to fuel starvation at high engine speeds and loads. When such symptoms are detected it will be necessary to remove the pump from the vehicle. Release the cover-plate and gasket from the bakelite moulding and withdraw the filter. Wash the filter in fuel, lightly blow through with air, and clean any sediment from the bakelite moulding. When replacing the cover-plate the cork gasket must be renewed.

Cleaning the contact points

If trouble from the contact points be suspected the top cover should be removed and the points cleaned by drawing a piece of clean paper or card between them. Great care must be taken during this operation to avoid overstressing the contact blades.

The extremities of the blades should bear downwards on the respective platforms provided on the bakelite contact breaker mounting plate after the operating rocker

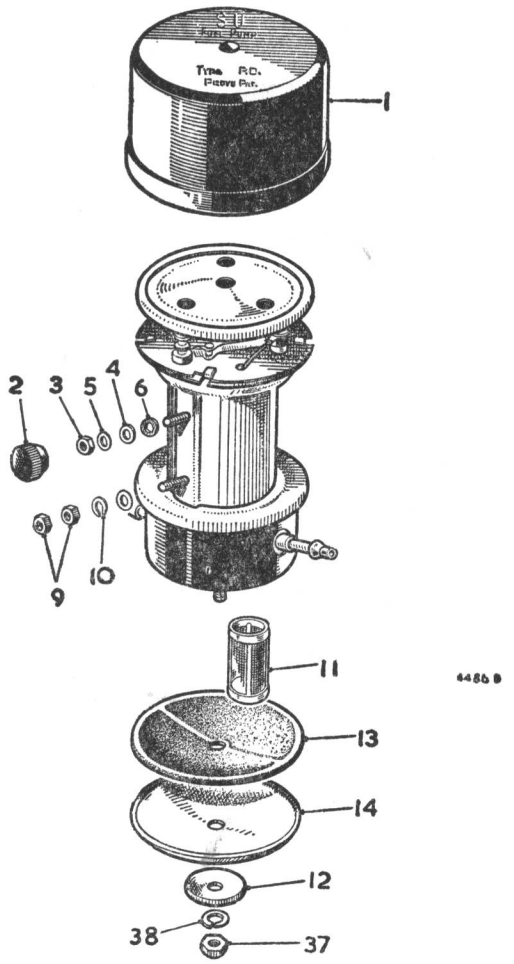


Fig. D.4

The S.U. type PD electric fuel pump. Only the components shown in the following key to the illustration are supplied for servicing

1. Top—cover.
2. Knob for terminal.
3. Nut for terminal.
4. Plain washer.
5. Lead washer.
6. Insulating collar.
9. Nut for earth terminal.
10. Washer for earth terminal.
11. Filter.
12. Dished washer.
13. Cork gasket.
14. Cover-plate.
37. Nut.
38. Spring washer.

has been manually moved over until its upper extremity contacts the brass centre tube. In this situation the blades should be straight and parallel, and the gap between the two pairs of contact points should be perceptible. When the rocker is then released both blades should be deflected upwards and mechanical contact between both pairs of points observed to be firmly established. The gap between the extremity of the upper contact blade and its stop face should then be not less than ·015 in. (·381 mm.).

It occasionally happens that, due to the pump having been dropped or otherwise roughly handled at some time, the above conditions are not fulfilled. In such cases a discreet resetting of the blades can generally be achieved, using a pair of thin-nosed pliers. It is essential that the downward bearing of the ends of the contact blades upon their stop faces, as described above, while being quite positive, should be extremely light.

Air leakage

Rapid operation accompanied by a diminished fuel delivery is indicative of air leakage into the suction side of the pump. This fault is best detected by disconnecting the delivery pipe at the carburetter and allowing fuel to discharge into an open receptacle with the end of the pipe submerged in the fuel. Should any significant quantity of air bubbles be observed, check and, if necessary, replace the cover-plate cork gasket. The rubber connections at either end of the suction line should be examined and renewed if they show signs of damage or deterioration.

Section D.4

CARBURETTER

Description

The HS2 carburetter is of the automatically expanding choke type in which the size of the main air passage (or choke) over the jet, and the effective area of the jet, are variable according to the degree of throttle opening used.

To serve the complete throttle range a single jet only is used, being a simple metal tube sliding in a single bearing bush, fed by fuel along a small-diameter nylon tube leading direct from the base of the float-chamber. The jet is varied in effective area by a tapered fuel metering needle sliding into it.

Piston sticking

The piston assembly comprises the suction disc and the piston forming the choke, into which is inserted the hardened and ground piston rod which engages in a bearing in the centre of the suction chamber and in which is, in turn, inserted the jet needle. The piston rod running in the bearing is the only part which is in actual contact with any other part, the suction disc, piston, and needle all having suitable clearances to prevent sticking. If sticking does occur the whole assembly should be cleaned carefully and the piston rod lubricated with a spot of thin oil. No oil must be applied to any other part except the piston rod. A sticking piston can be ascertained by removing the piston damper and lifting the piston by pressing the piston lifting pin; the piston should come up quite freely and fall back smartly onto its seating when released. On no account should the piston return spring be stretched or its tension altered in an attempt to improve its rate of return.

Water and dirt in the carburetter

Should a blocked jet be suspected, start the engine, open the throttle, and block up the air inlet momentarily, keeping the throttle open until the engine starts to race.

If the jet is completely blocked and the engine will not run, the jet must be removed and thoroughly cleaned.

Float-chamber flooding

This is indicated by fuel flowing from the breather hole in the top of the float-chamber lid below the main fuel feed pipe, and is generally caused by grit between the float-chamber needle and its guide. The float-chamber lid should be removed and the needle and its guide thoroughly cleaned.

Float needle sticking

If the engine stops, apparently through lack of fuel, when there is plenty in the tank and the pump is working properly, the probable cause is a sticking float needle. An easy test for this is to disconnect the pipe from the electric pump to the carburetter and switch the ignition on and off quickly while the end of the pipe is directed onto a pad of cloth or into a container.

If fuel is delivered, starvation is almost certainly being caused by the float needle sticking to its seating, and the float-chamber lid should therefore be removed and the needle and seating cleaned and refitted.

At the same time it will be advisable to clean out the entire fuel feed system as this trouble is caused by foreign matter in the fuel, and unless this is removed it is likely to recur. It is of no use whatever renewing any of the component parts of the carburetter, and the only cure is to make sure that the fuel tank and pipe lines are entirely free from any kind of foreign matter or sticky substance capable of causing this trouble.

Adjustments

Slow-running is governed by the setting of the jet adjusting nut and the throttle adjusting screw, both of which must be correctly set and synchronized if satisfactory results are to be obtained.

Before blaming the carburetter setting for bad slow-running make certain that the trouble is not caused by badly adjusted distributor contact points, faulty plugs, incorrect valve clearance, or faulty valves and springs. Check the oil level of the piston damper and top up with thin engine oil.

Adjusting the jets

Run the engine until it attains its normal running temperature.

Remove the air cleaner.

Disconnect the mixture control cable.

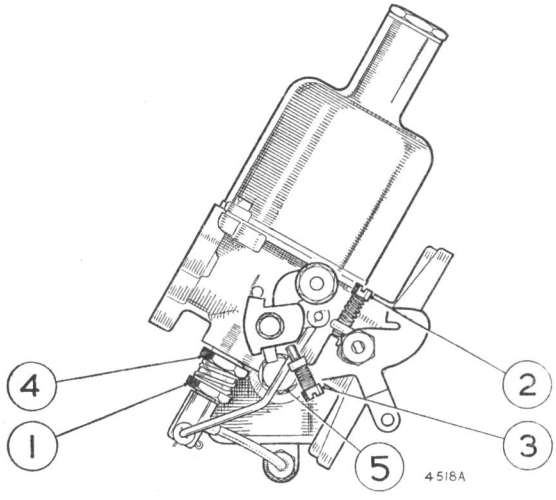


Fig. D.5

The carburetter adjusting screws

1. Jet adjusting nut.
2. Throttle adjusting screw.
3. Fast-idle adjustment screw.
4. Jet locking nut.
5. Float-chamber bolt.

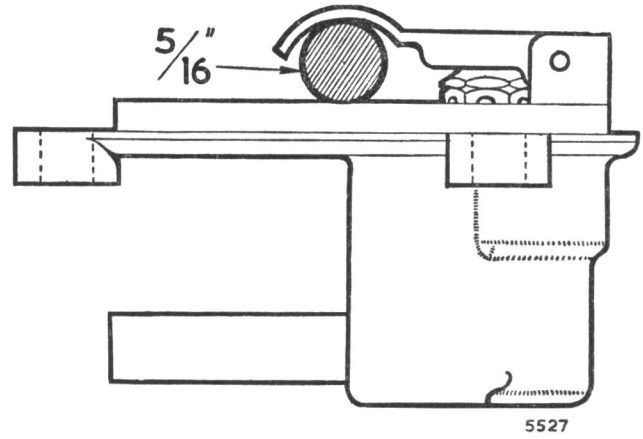


Fig. D.6

The method of checking the correct adjustment of the float lever

Unscrew the throttle lever adjusting screw until the throttle is completely closed. Turn the adjusting screw in a clockwise direction approximately one turn to set the throttle for fast idling.

With the engine running, set the jet adjusting nut so that a mixture strength is obtained which will give the best running speed for this particular throttle opening, taking care to see that the jet head is in firm contact with the adjusting nut the whole time.

The correctness or otherwise of this setting can be checked by raising the suction piston about $\frac{1}{32}$ in. (1 mm.). This should cause a very slight momentary increase in the speed of the engine without impairing the evenness of the running. If the engine stops the mixture is too weak. If the speed increases and continues to increase when the piston is raised as much as $\frac{1}{4}$ in. (6 mm.) the mixture is too rich.

When the carburetter is correctly adjusted for mixture set the throttle adjusting screw to give the required slow-running.

Slow-running

Turn the throttle adjusting screw to give a fast idling speed. Then unscrew, a fraction of a turn at a time, until the desired slow-running is obtained.

Float-chamber

The position of the hinged lever in the float-chamber must be such that the level of the float (and therefore the height of the fuel at the jet) is correct.

This is checked by inserting a $\frac{5}{16}$ in. (7·94 mm.) round bar between the lever and the machined lip of the float-chamber lid. The curved end of the lever should just rest on the bar (see Fig. D.6) when the needle is on its seating. If this is not so, the lever should be reset at the point where the curved end meets the shank.

Do not bend the shank, which must be perfectly flat and at right angles to the needle when it is on its seating.

Centring the jet

When the suction piston is lifted by the spring-loaded piston lifting pin it should fall freely and hit the inside jet bridge with a soft, metallic click—that is, with the jet adjusting nut (2) (Fig. D.7) in its topmost position.

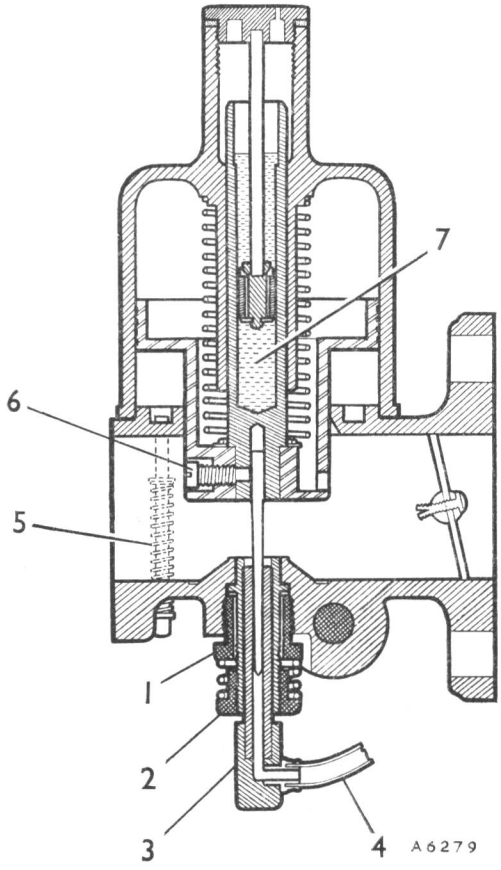


Fig. D.7

A section through the carburetter showing:

1. Jet locking nut.
2. Jet adjusting nut.
3. Jet head.
4. Nylon fuel pipe.
5. Piston lifting pin.
6. Needle securing screw.
7. Piston damper oil well.

If this click is not audible, but is so when the test is repeated with the jet in the fully lowered position, then the jet unit requires recentring on the needle, as described below.

(1) Disconnect the rod between the jet lever and the jet head (3) (Fig. D.7).

(2) Unscrew the union holding the nylon feed tube into the base of the float-chamber, and withdraw the tube and jet together. Unscrew the jet adjusting nut and remove the lock spring. Replace the adjusting nut and screw it right up to its topmost position, then replace the jet and feed tube.

(3) Slacken off the large jet locking nut (1) (Fig. D.7) until the jet bearing is just free to rotate by finger pressure.

(4) With the damper removed and using a pencil on top of the piston rod, gently press the piston and needle down onto the jet bridge.

(5) Tighten the jet locking nut, observing that the jet head is still in its correct angular position.

(6) Lift the piston and check that it falls freely and evenly, hitting the jet bridge with a soft, metallic click. Then fully lower the jet and re-check to see if there is any difference in the sound of the impact; if there is and the second test produces a sharper impact sound, the centring operation will have to be repeated until successful, the nut and lock spring being replaced after the conclusion of the operation.

Needle

Mark the suction chamber and carburetter for correct refitting.

Remove the piston and suction chamber assembly. Slacken the needle clamping screw, extract the needle and check its identifying mark (see **'GENERAL DATA'**). Refit the correct needle, ensuring that the shoulder on the shank is flush with the piston base.

Removing from engine

Remove the air cleaner as detailed in Section D.5.

Disconnect the mixture and throttle control cables, the suction advance pipe, and the fuel delivery hose from their respective positions on the carburetter.

Remove the two nuts and spring washers securing the carburetter to the manifold flange. Lift off the carburetter and the cable abutment plate.

Refitting

It should be noted that the cable abutment plate fitted between the carburetter and manifold flange has a gasket fitted on both faces. Should either gasket be damaged, the plate and the flanges must be thoroughly cleaned and new gaskets fitted.

Section D.5

AIR CLEANER

Removing

To remove the element for cleansing, unscrew the wing nut from the top of the cleaner, remove the cover, and extract the element. Tap the element gently or blow air from the inside to remove all dust deposit. Wipe the inside of the container before refitting the element.

To remove the air cleaner body disconnect the breather hose from the rocker cover, slacken the air cleaner retaining clip on the air intake pipe, and lift the cleaner from the engine.

Section D.6

INDUCTION AND CARBURETTER SUCTION CHAMBER HEATERS

Heaters are fitted between the carburetter and the induction manifold and to the carburetter suction chamber on models exported to countries where conditions of extreme cold exist.

The induction heater is fitted with the bulb of the thermostat pointing inwards towards the centre-line of the engine and the insulating washer against the manifold. Earth return is through a small cut-away in the insulating washer, and contact is made against the manifold flange. The accelerator cable abutment plate is interposed between the heater and the carburetter with an insulating washer on each side of the plate.

The carburetter suction chamber heater is fitted on the outside of the suction chamber and secured in position with a retaining clip. The lead is connected to the thermostat on the induction heater.

Section D.7

FUEL TANK
(Van, Countryman, and Traveller)

Removing

Unscrew the drain plug in the bottom of the tank and drain the fuel into a suitable container. Remove the filler cap and disconnect the lead from the fuel tank gauge unit; disconnect the fuel pipe from the tank connection. Support the tank and remove the six screws that secure the tank flange to the body. Lower the tank to the ground and retain the nylon spacers.

Refitting

Position the tank beneath the body and insert the nylon spacers between the holes in the tank flange and the holes in the body; secure the tank to the body with the screws.

Connect the lead to the fuel tank gauge unit and the fuel pipe to the tank connection. Refit the filler cap and replace the drain plug. The fuel tank is vented through the filler cap, and it is essential that only the correct type of cap is fitted.

Section D.8

AIR CLEANER
(Impregnated Element)

A chemically impregnated filter element is fitted in the air cleaner from Car Nos. MA2S4 14794 and AA2S7 13398. Fit a new element at the periods stated in the Passport to Service, or earlier in dusty operating conditions. Do not disturb the air cleaner cover or remove the element at any other time.

When fitting an impregnated element to a car previously fitted with a non-impregnated element the conflicting service instructions appearing on the filter body should be obliterated.

NOTE.—The air cleaner intake should be positioned adjacent to the exhaust manifold during winter operating conditions in order that the possibility of carburetter icing is reduced to the minimum. It is advisable to move the intake away from the manifold in warmer weather.

Section D.9

FUEL TANK
(Countryman and Traveller—Early Models)

Removing

Slacken off the screws and remove the trim liner from the body side immediately above the tank and the metal finishers from the rear seat squab support.

Lift out the luggage platform floor, disconnect the battery, and ease the trim panel away from the tank.

Drain the fuel from the tank, remove the drain tube, and disconnect the fuel delivery pipe at the tank union.

Remove the set screws securing the tank to the support brackets.

Disconnect the fuel gauge lead and pull the breather pipe from the connector on the tank.

Remove the fuel filler cap and manœuvre the tank from the vehicle.

Refitting

Refitting is a reversal of the dismantling procedure. Make certain that the breather pipe is pushed firmly onto the connector, secured by its retaining clip inside the vehicle, and fastened away from the exhaust pipe underneath.

Section D.10

SP FUEL PUMP

Description

The SP fuel pump is of conventional design, having a flexible diaphragm and an armature assembly operated by a solenoid. The electrical circuit to the solenoid is opened and closed by a contact breaker mechanism operated by an armature spindle. The electrical connections to the pump are by a terminal knob and a Lucar connector.

The pump consists of three main parts—namely, a body, a diaphragm armature and coil housing assembly, and a contact breaker assembly.

The body is a zinc-alloy die-casting and has on its outer face integral inlet and outlet connections and two tapped lugs for mounting purposes. An inlet nozzle which houses a filter is screwed into the inlet connection; the outlet connection is pressed into the body and is not detachable.

Two seatings machined within the body accommodate the inlet valve and the outlet valve respectively. The inlet valve comprises a disc of Melinex film which is lightly loaded onto its seating within the body. The outlet valve, also of Melinex film, is loaded by means of a light spring onto a carrier plate; the plate locates on the remaining seat in the body. The valves are retained on their seats by a valve retainer which is secured to the body by a recessed pan-head screw.

The pumping element comprises a pair of neoprene diaphragms supported by stiffening washers to prevent flutter and bagging of the diaphragm; breather holes in the inner diaphragm prevent vapour accumulating between the discs. The centre of the diaphragm is clamped to a sintered iron armature by means of a screwed clamping plate and an armature spindle. Eleven brass rollers located between the armature and the coil housing centralize the armature within the housing and also ensure that the periphery of the armature does not contact the mouth of the housing during the power stroke.

A feed spring is interposed between the armature and the solenoid and a rubberized impact washer is located on the face of the armature to reduce noise in operation when the pump is priming.

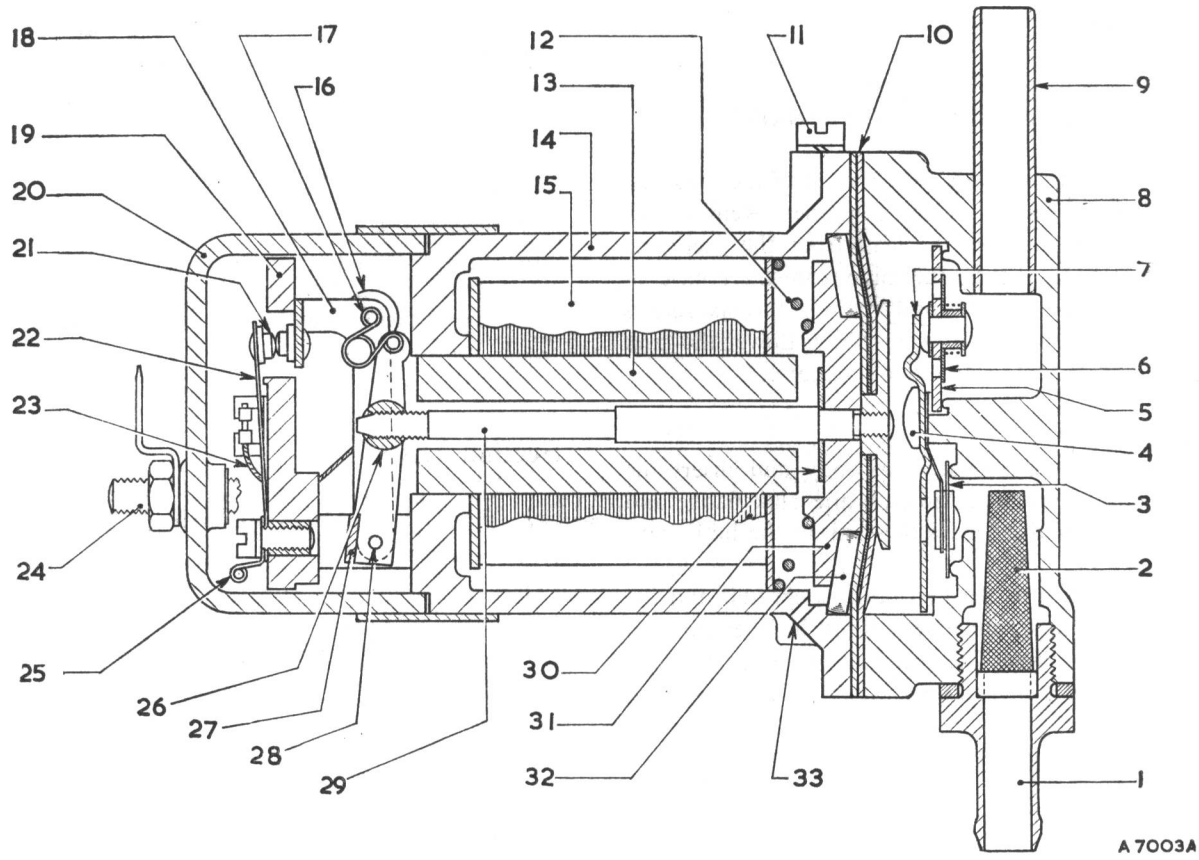


Fig. D.8

The SP-type fuel pump

1. Feed nozzle.
2. Filter.
3. Inlet valve.
4. Screw—valve retainer.
5. Carrier plate.
6. Delivery valve.
7. Valve retainer.
8. Body.
9. Outlet connection.
10. Diaphragm.
11. Earth screw.
12. Feed spring.
13. Solenoid core.
14. Coil housing.
15. Coil.
16. Fibre rollers.
17. Toggle spring.
18. Outer rocker.
19. Pedestal.
20. End cap.
21. Contact points.
22. Spring blade.
23. Braided earth wire.
24. Terminal screw.
25. Coil lead tag.
26. Trunnion.
27. Inner rocker.
28. Rocker hinge pin.
29. Armature spindle.
30. Impact washer.
31. Armature.
32. Brass rollers.
33. Air vent.

A central iron core pressed into the blind end of the coil housing supports the solenoid winding. A central bore through the core permits the armature spindle to pass freely through the core to the contact breaker mechanism. An atmospheric vent is provided at the bottom of the coil housing to accommodate the pulsation of air at the coil side of the diaphragm and an earthing screw is provided in the housing flange.

The contact breaker assembly is mounted on a pedestal secured by two screws to the top face of the coil housing. The armature spindle is screwed into a trunnion member which is pivotally mounted within a channel section inner rocker. One end of the inner rocker is mounted on a common hinge with the end of an outer rocker; the two rockers are mechanically connected through the medium of a toggle spring assembly made up of two springs attached by pivot pins to the extremities of the rocker arms. The pivot pin through the outer rocker also carries two fibre rollers which contact the face of the coil housing during the operation of the pump. A pair of tungsten points on the free end of the outer rocker make contact with a corresponding pair of points carried by a spring blade secured to the upper face of the pedestal. A terminal screw which forms the main electrical connection to the pump is fitted to the upper face of the pedestal and passes through a bakelite cap that encloses the whole of the contact breaker assembly.

From the terminal screw a lead passes to one end of the coil winding and the return lead from the coil is connected to a tag attached to the spring blade. When the contacts are closed the current passes through the contacts to the outer rocker arm, through a braided copper earth wire to one of the pedestal securing screws, and so to the coil housing. The separate earthing screw on the

housing completes the circuit. Provision against excessive sparking at the contact points at the moment of break is made by the inclusion of a high-resistance leak wire in the coil winding.

Section D.11

OPERATION OF THE SP FUEL PUMP

When the pump is at rest the armature and diaphragm assembly is deflected towards the pumping chamber by the feed spring, the armature spindle retains the inner rocker in its lower position, and the spring toggle retains the outer rocker in its upper position to make firm contact with the points on the spring blade.

When the pump is switched on the solenoid winding is energized and draws the armature and diaphragm assembly towards it, overcoming the loading of the feed spring. The volume of the pumping chamber is thus increased and fuel is drawn in through the inlet valve. Simultaneously the armature spindle rotates the inner rocker about its pivot pin and the toggle spring moves the outer rocker downwards until the fibre rollers contact the upper face of the coil housing. This movement of the outer rocker separates the contact points and de-energizes the solenoid.

The armature and diaphragm assembly, under the action of the feed spring, moves towards the pumping chamber and forces fuel from the chamber out through the delivery valve. As the armature spindle moves with the diaphragm assembly the inner rocker is again rotated about its pivot pin and the toggle spring moves the outer rocker upwards until the points again make contact, when the cycle of operations is repeated.

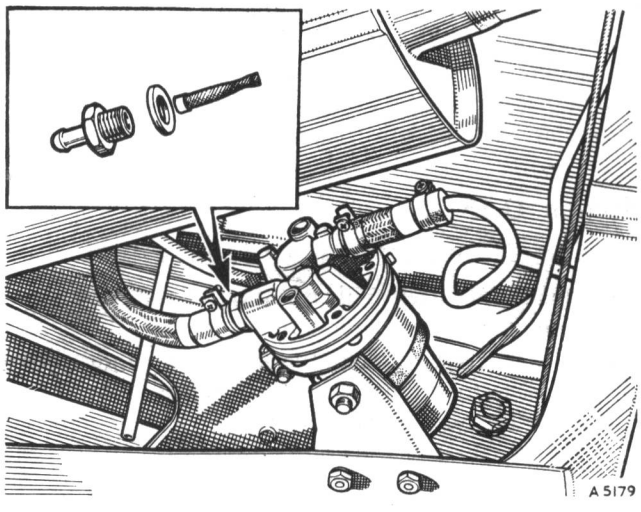


Fig. D.9

The fuel pump mounting. The inlet nozzle and filter are shown removed (inset)

Section D.12

FUEL PUMP MOUNTING

The fuel pump is mounted on the lower flange of the rear sub-frame on the left-hand side.

Removing and refitting

Disconnect the battery earth lead.

Slacken the clip securing the flexible pipe from the tank to the inlet nozzle on the pump and pull off the pipe. Plug the end of the pipe to prevent fuel draining out. A $\frac{5}{16}$ in. (7·93 mm.) bolt is a suitable plug. Slacken the retaining clip and pull off the flexible pipe from the outlet nozzle of the pump.

Disconnect the electrical leads from their connections on the pump, slacken and remove the nut and spring washer securing the fuel pump clamp to the bracket on the sub-frame, and remove the pump assembly.

Refitting is a reversal of the removal procedure.

Section D.13

DISMANTLING THE SP FUEL PUMP

(1) Unscrew the inlet nozzle and from it remove the filter and the fibre washer.

(2) Unscrew the six screws securing the coil housing to the body and carefully detach the outer periphery of the diaphragm from the body and the coil housing.

(3) Remove the pan-head recessed screw securing the valve retainer to the body and withdraw the retainer and the two valves.

(4) Unscrew the armature from the inner rocker trunnion and remove the brass rollers, the feed spring, and the impact washer from the armature.

(5) Remove the terminal nut. Lucar connector, and washer from the terminal screw and take off the bakelite cap.

(6) Unscrew the spring blade securing screw and disconnect the coil lead. Remove the terminal screw retaining nut, cut the lead washer, then unscrew the two pedestal retaining screws and disconnect the braided copper earth lead.

(7) Turn the pedestal on its side, and remove the remaining coil lead from the terminal screw and the screw from the pedestal.

(8) Push the inner and outer rocker pivot pin from the pedestal and remove the rocker assembly.
Do not remove the toggle springs.

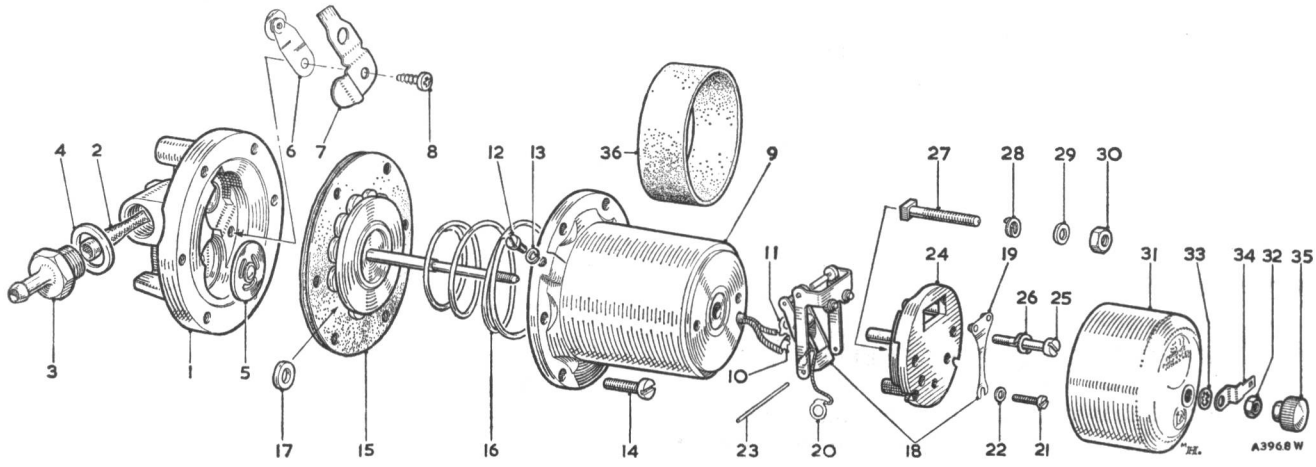


Fig. D.10

The SP-type fuel pump components

1. Body.
2. Filter.
3. Nozzle inlet.
4. Washer for nozzle.
5. Valve—outlet.
6. Valve—inlet.
7. Retainer—valve.
8. Screw for retainer.
9. Housing—coil.
10. Tag—5 B.A. terminal.
11. Tag—2 B.A. terminal.
12. Screw—earth.
13. Earth screw.
14. Screw—housing to body.
15. Diaphragm assembly.
16. Spring.
17. Roller.
18. Rocker and blade.
19. Blade.
20. Tag—2 B.A. terminal.
21. Screw for blade.
22. Washer—dished.
23. Spindle for contact breaker.
24. Pedestal.
25. Screw—pedestal to housing.
26. Washer—spring.
27. Screw for terminal.
28. Washer—spring.
29. Washer—lead—for screw.
30. Nut for screw.
31. Cover—end.
32. Nut for cover.
33. Washer—shakeproof.
34. Connector—Lucar.
35. Knob—terminal.
36. Sleeve—rubber.

Section D.14

INSPECTING THE SP FUEL PUMP

Thoroughly clean all parts of the pump in clean paraffin (kerosene) and then examine for cracks, fractures, wear, deterioration, and thread damage. Worn or damaged parts must be renewed.

Metal parts that have been contaminated with gum formation from the fuel will be coated with a substance similar to varnish. **Brass and steel parts** so affected are to be boiled in a 20 per cent. solution of caustic soda, dipped in a strong nitric acid solution, and, finally, thoroughly washed in boiling water. **Light-alloy parts** must be well soaked in methylated spirit and then cleaned.

Check the weight of the feed spring: it must compress to a length of ·10 in. (2·54 mm.) under a load of between 7½ and 8 lb. (3·42 and 3·62 kg.).

Examine the outlet valve and ensure that the valve spring functions correctly. Assemble the valves to their respective seats, retain them with the valve retainer, and test each valve in turn by alternately sucking and blowing at the inlet and at the outlet connection. The inlet valve must unseat when blowing through the inlet connection and seat when sucking at the connection. The outlet valve must seat when blowing through the outlet connection and unseat when sucking.

Examine the contact breaker points. If burning or pitting of the points is evident, the rocker assembly and the spring blade must be renewed.

Section D.15

ASSEMBLING THE SP FUEL PUMP

(1) Place the valves on their respective seats and retain them with the valve retainer.
(2) Insert the filter into the nozzle, fit a new fibre washer to the nozzle, and then screw the nozzle into the inlet connection.
(3) Secure the free ends of the rocker assembly to the pedestal with the pivot pin.
(4) Fit the terminal screw to the pedestal and replace the spring washer and the short lead from the coil. Fit a new lead washer to the terminal screw and secure it with the nut.

(5) Connect the braided copper earth lead from the outer rocker to the nearest pedestal securing screw and ensure that the tag is next to the head of the screw. Secure the pedestal to the face of the coil housing with the two spring washers and screws.

(6) Fit the remaining coil lead to the 4 B.A. screw, position the spring blade on the pedestal, and lightly secure it with the screw.

NOTE.—The blade must bear against the small rib formed on the top face of the pedestal and the tag of the solenoid lead must be on top of the blade.

(7) Adjust the spring blade until the points are making firm and positive contact and ensure that the points on the blade or rocker wipes over the centre-line of the other points when the outer rocker arm is moved up and down.

(8) Tighten the spring blade securing screw and re-check the setting. In this position the free end of the spring blade must be deflected away from the small rib on the face of the pedestal so that an appreciable gap exists between the under side of the blade and the rib.

(9) Depress the outer rocker arm and ensure that the spring blade rests on the rib. If it does not, remove and lightly set the blade towards the pedestal.

(10) Assemble the impact washer and the feed spring to the armature spindle, pass the spindle through the centre of the solenoid core, and screw it onto the trunnion on the inner rocker.

(11) Adjust the armature spindle until a firm, steady pressure on the armature assembly just fails to cause the outer rocker to snap over from the 'contact made' to 'contact broken' position. Then unscrew the armature spindle seven holes. This will ensure an adequate margin in the contact breaking operation against the eventuality of subsequent wear or any increase in friction in the moving parts of the contact breaker mechanism.

(12) Position the brass rollers between the armature and the diaphragm, fit the body to the coil housing, and secure them with the six screws.

(13) Replace the bakelite cap, fit the spring washer, Lucar connector, and nut to the terminal screw, and replace the terminal knob.

(14) Fit the rubber sleeve to the body of the pump and dust excluders to the inlet and the outlet connections.

Section D.16

TESTING THE SP FUEL PUMP

(1) Check that the pump points are correctly gapped and adjusted.

(2) Fit an SP pump adaptor set to a standard test rig and mount the pump on the rig (see Fig. D.11). In order to observe the action of the contact breaker assembly fit a cut-away cover to the pump.

(3) Connect the pump to a 12-volt electrical supply with a resistance and a voltmeter in the circuit.

(4) Ensure that there is an adequate supply of paraffin (kerosene) in the test rig tank.

Priming and maximum delivery check

Open the tap on the test rig and switch on the pump. The pump should prime from dry in 10 to 15 seconds and the fuel should rise in the glass jar until it flows over the top of the drain pipe. If the fuel level does not rise above the small hole in the drain pipe, then the pump is not operating at the required standard and must be inspected.

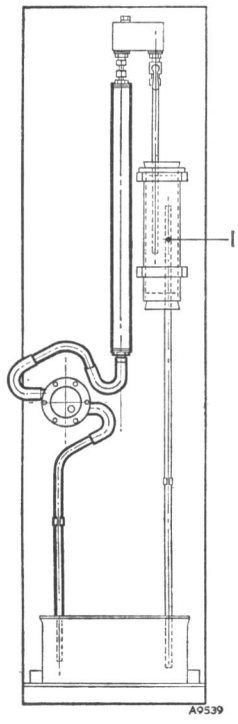


Fig. D.11

A checking rig for the fuel pump is obtainable from the S.U. Carburetter Co. Ltd.

(1) The $\frac{5}{32}$ in. (4 mm.) dia. hole is 2 in. (50 mm.) below the top of the pipe

Air leak check

When the pump is first switched on air bubbles will be seen emerging from the drain pipe. These bubbles should cease after the pump has been operating for a minute or two. If the bubbles continue to appear it is an indication that an air leak exists on the suction side of the pump and this must be found and rectified.

Valve seat check

Operate the pump for about 10 minutes and then turn the tap right off. The pump should not beat for at least 12 seconds. If the pumping action takes place within 12 seconds the inlet valve is not seating correctly and must be reseated.

Minimum delivery check

Partially open the tap and check that fuel is delivered to the glass jar. Gradually depress the spring blade to reduce the stroke; the pump should continue working with increasing frequency until it eventually stops due to there being no gap left between the points.

Reduced voltage check

Turn the tap fully on, reduce the voltage to 9·5 volts, and check that the pump is functioning satisfactorily.

Sparking check

Switch on the pump and check for excessive sparking between the points. A small degree of sparking is permissible, but a special leak wire in the solenoid winding is designed to reduce sparking to a minimum. If excessive sparking is evident the solenoid assembly must be renewed.

Section D.17

THE AUF 201 FUEL PUMP

The construction of the AUF 201 fuel pump is similar to the SP fuel pump described in Section D.10.

The main body and contact breaker assembly differ in design only (see Figs. D.13 and D.15), the pump operating as the SP pump described in Section D.11.

An atmospheric vent is provided at the bottom of the magnet housing to allow air to pass into the magnet side of the diaphragm. This is connected to the interior of the vehicle by a nylon tube. A non-return ball valve is fitted to the bakelite cover of the pump which allows air to pass from the inside of the pump to the atmosphere. The action of the diaphragm draws in air through the nylon tube and passes the air through the magnet housing, over the contact points and out through the non-return valve in the bakelite cover. A current of air is thereby continually passing over the contact points cooling them and prolonging their life.

Dismantling

(1) Unscrew the six screws securing the coil housing to the body and detach the outer periphery of the diaphragm from the body and the coil housing.

(2) Unscrew the diaphragm assembly from its trunnion in the contact breaker by rotating the whole assembly in an anti-clockwise direction; the easiest method is to hold the body and rotate the diaphragm. Take care not to lose the brass rollers fitted behind the diaphragm.

(3) Remove the terminal nut, Lucar connector, and washer from the terminal screw and take off the bakelite cap.

(4) Unscrew the spring blade securing screw and disconnect the coil lead. Remove the terminal screw retaining nut, cut the lead washers, and then unscrew the two pedestal retaining screws and disconnect the braided copper earth lead.

(5) Turn the pedestal on its side and remove the remaining coil lead from the terminal screw and the screw from the pedestal.

(6) Push the inner and outer rocker pivot pin from the pedestal and remove the rocker assembly.

Do not disturb the core of the magnet; it can only be located correctly with special press tools.

Inspecting

Inspect the fuel pump as described in Section D.14.

Assembling

(1) Fit the inlet valve with its tongue downwards, followed by the filter with a sealing washer each side. Fit the outlet valve with its tongue uppermost, followed by a sealing washer. Replace the covers and secure with the spring clamp.

(2) Secure the free ends of the rocker assembly to the pedestal with the pivot pin.

(3) Fit the terminal screw to the pedestal and replace the spring washer and the short lead from the coil. Fit a new lead washer to the terminal screw and secure it with the nut (see Fig. D.12).

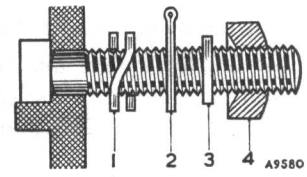


Fig. D.12

The correct sequence of assembly of components on the terminal screw

1. Spring washer.
2. Wiring tag.
3. Lead washer.
4. Recessed nut.

(4) Connect the braided copper earth lead from the outer rocker to the nearest pedestal securing screw and ensure that the tag is next to the head of the screw. Secure the pedestal to the face of the coil housing with the two spring washers and screws.

(5) Fit the remaining coil lead to the 4 B.A. screw, position the spring blade on the pedestal, and lightly secure it with the screw.

NOTE.—The blade must bear against the small rib formed on the top face of the pedestal and the tag of the solenoid lead must be on top of the blade.

(6) Adjust the spring blade securing screw until the centre-line of the points on the blade wipes over the centre-line of the points on the rocker.

(7) Tighten the spring blade securing screw and recheck the setting. In this position the free end of the spring blade must be deflected away from the small rib on the face of the pedestal so that an appreciable gap exists between the under side of the blade and the rib.

(8) Depress the outer rocker arm and ensure that the spring blade rests on the rib. If it does not, remove and lightly set the blade towards the pedestal.

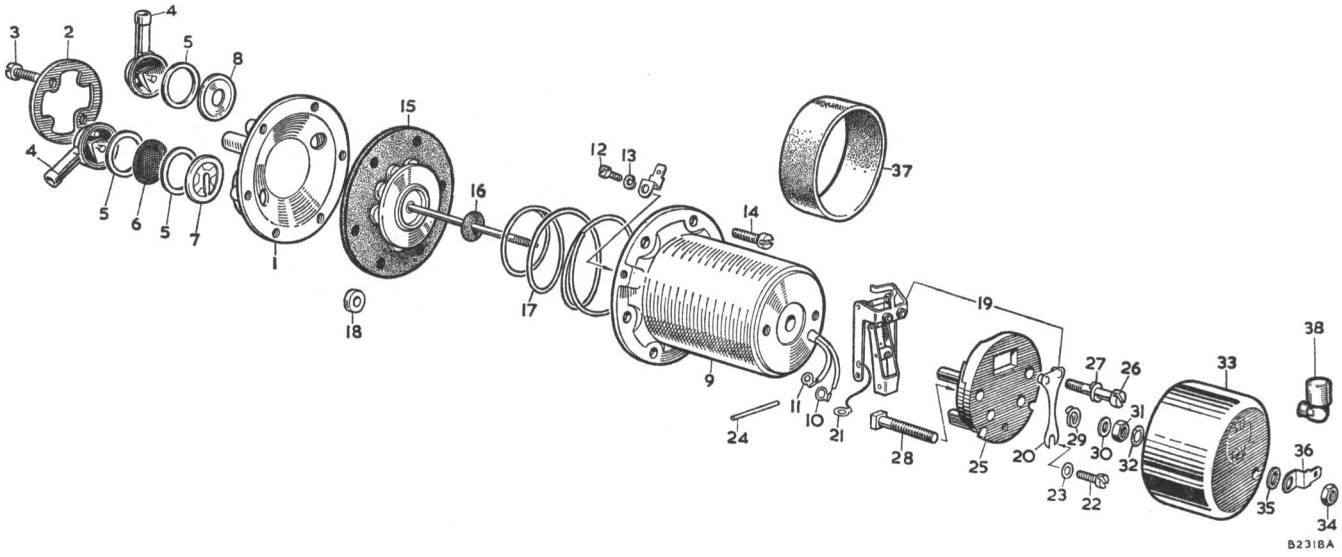


Fig. D.13

The AUF 201 fuel pump components

No.	*Description*
1.	Body.
2.	Spring clamp plate.
3.	Screw.
4.	Nozzle—inlet/outlet.
5.	Sealing washer.
6.	Filter.
7.	Valve—inlet.
8.	Valve—outlet.
9.	Housing—coil.
10.	Tag—5 B.A. terminal.
11.	Tag—2 B.A. terminal.
12.	Screw—earth.
13.	Washer—spring.
14.	Screw—housing to body.
15.	Diaphragm assembly.
16.	Impact washer.
17.	Spring.
18.	Roller.
19.	Rocker and blade.
20.	Blade.
21.	Tag—2 B.A. terminal.
22.	Screw for blade.
23.	Washer—dished.
24.	Spindle for contact breaker.
25.	Pedestal.
26.	Screw—pedestal to housing.
27.	Washer—spring.
28.	Screw for terminal.
29.	Washer—spring.
30.	Washer—lead—for screw.
31.	Nut for screw.
32.	Spacer—nut to cover.
33.	Cover—end.
34.	Nut for cover.
35.	Washer—shakeproof.
36.	Connector—Lucar.
37.	Packing sleeve.
38.	Non-return valve.

(9) Assemble the impact washer and the feed spring to the armature spindle, pass the spindle through the centre of the solenoid core, and screw it onto the trunnion on the inner rocker.

(10) Adjust the armature spindle until a firm, steady pressure on the armature assembly just fails to cause the outer rocker to snap over from the 'contact made' to 'contact broken' position (Fig. D.14). Then unscrew the armature spindle seven holes. Subsequent wear or increase in friction in the contact breaker mechanism will be taken care of by this margin of adjustment.

(11) Position the brass rollers between the armature and the diaphragm, fit the body to the coil housing, and secure it with the six screws.

(12) Replace the bakelite cap, and fit the spring washer, Lucar connector, and nut to the terminal screw.

If the pump is not to be fitted to the vehicle for some time tape up the inlet and outlet ports.

Adjusting

If the diaphragm has been disturbed it will be necessary to reset the position of the diaphragm spindle in the rocker trunnion as follows.

Slacken the screw securing the spring blade and swing the blade to one side so that the points no longer make contact. Holding the coil housing in the left hand, screw in the diaphragm with the thumb of the right hand, alternately pressing and turning until the rocker throw-over ceases (see Fig. D.14). Unscrew the diaphragm one-sixth of a turn at a time (one securing hole) in the same manner, slowly pressing and turning until the rocker throw-over mechanism just operates; at this point continue unscrewing the diaphragm a further amount equal to 1¼ turns (seven securing screw holes). Assemble the coil housing to the main body and replace the six screws. Check that the top of the inner rocker has made contact with the end face of the coil housing. If there is a visible or measurable gap, the six screws should be slackened off and then retightened until the inner rocker is in contact with the coil housing. The spring blade (previously swung to one side) should now be replaced in its normal position. The slot in the blade is provided with an adequate clearance round its attachment screw: this allows the blade to be repositioned so that when the outer rocker makes or breaks contact between the tungsten points they wipe over the centre-line of the other pair symmetrically.

The rocker mechanism and spring blade should be set so that when the outer rocker is pressed onto the coil housing the spring blade rests on the narrow ridge which projects above the pedestal moulding (see Fig. D.15).

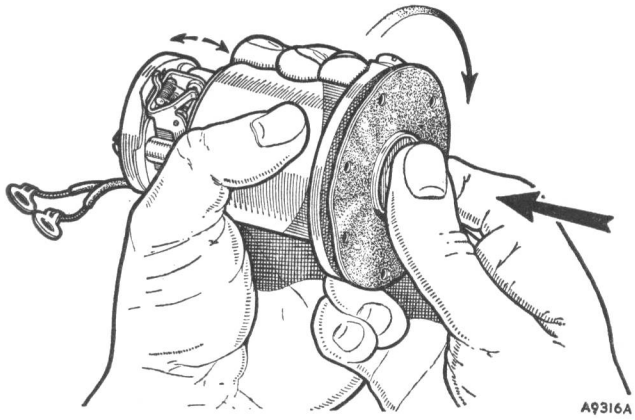


Fig. D.14

Screw in the diaphragm until the rocker throw-over ceases

In this position the gap between the points should be ·030 in. (·76 mm.). When the outer rocker is released the spring blade should be deflected away from the ridge. If necessary, the blade and/or rocker fingers can be set to achieve this position.

Testing

Test the pump on a test rig (see Fig. D.11) as described in Section D.16.

Testing on the vehicle

Should the pump cease to function, first disconnect the fuel delivery pipe from the pump. If the pump then works, the most likely cause of the trouble is a sticking needle in the carburetter float-chamber. Should the pump not work, disconnect the lead from the terminal and check with a voltmeter between the terminal and earth after switching on the ignition. If a correct reading is obtained the necessary current is available at the terminals and the trouble is the pump mechanism. If no current can be detected, check the battery and wiring. If current is present, further investigations should be carried out by removing the bakelite cover which is retained by the terminal nut. Touch the terminal with the lead. If the pump does not operate and the contact points are in contact, it is very probable that the contact points are dirty and require cleaning. These may be cleaned by inserting a piece of card between them, pinching them together, and sliding the card backwards and forwards.

Section D.18

NYLON FLOAT ADJUSTMENT

To check the float level, hold the float-chamber lid and float assembly upside down and place a $\frac{1}{8}$ in., (3·18 mm.) diameter bar across the diameter of the machined lip of the float-chamber lid, parallel to the float lever hinge pin, and under the float lever (see Fig. D.16). The face of the float lever should just rest on the bar when the float needle is held fully on its seating by the lever. If this is not so, carefully re-set the angle made between the straight portion of the float lever and its hinge until the correct position is obtained.

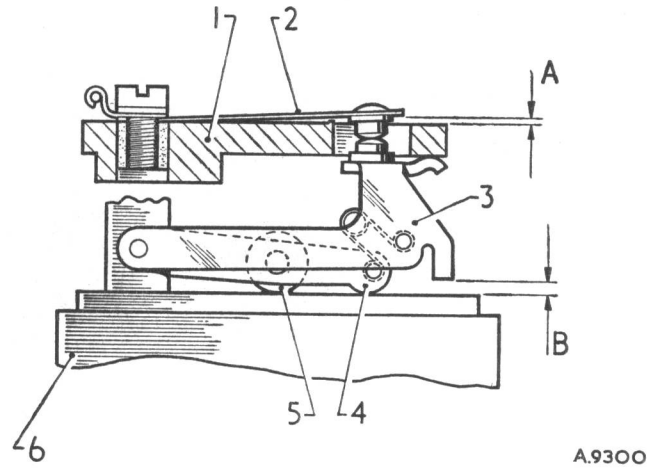


Fig. D.15

The rocker finger settings

A. ·035 in. ± ·005 in. (·89 mm. ± ·12 mm.).
B. ·070 in. ± ·005 in. (1·78 mm. ± ·12 mm.).
1. Pedestal.
2. Contact blade.
3. Outer rocker.
4. Inner rocker.
5. Trunnion.
6. Coil housing.

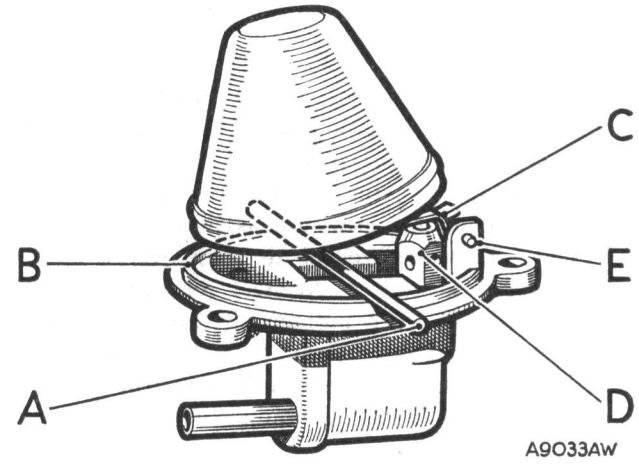


Fig. D.16

The method of checking the correct adjustment of the float lever

A. $\frac{1}{8}$ in. (3·18 mm.) bar.
B. Machined lip.
C. Angle of float lever.
D. Float needle and seat assembly.
E. Lever hinge pin.

Section D.19

FUEL PUMP
(Moke)

The fuel pump is located in the pannier of the left-hand side-member.

Removing

(1) Disconnect the battery.
(2) Remove the pannier side cover (two quick-release fasteners).
(3) Disconnect the lead from the pump terminal.
(4) Slacken the clips and pull the hose from the delivery pipe, and the suction hose from the pump.
(5) Remove two nuts to release the mounting bracket.

Dismantling and assembling

(6) Follow the instructions in Section D.17.

Refitting

(7) Reverse the removal instructions, tighten all clips, and secure the earth lead with one of the mounting bracket nuts.

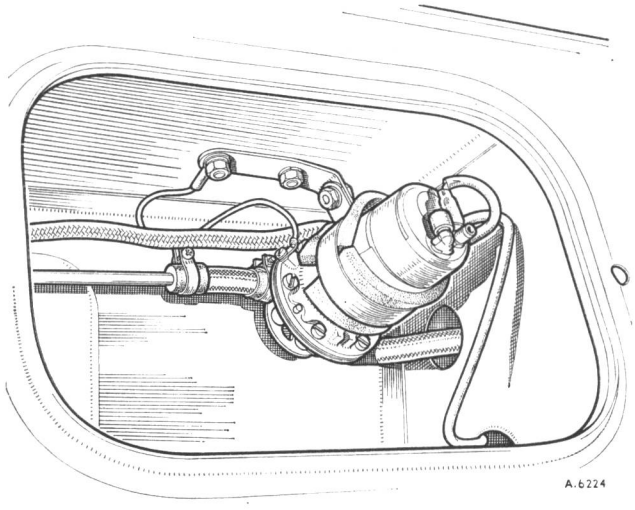


Fig. D.17
The fuel pump location in the left-hand side-member

Section D.20

FUEL TANK
(Moke)

The fuel tank is located in the left-hand side-member. Remove the tank for access to the gauge unit.

Removal

(1) Remove the forwards pannier side cover and disconnect the lead from the fuel gauge unit terminal.
(2) Drain the fuel tank (see Fig. D.18).
(3) Disconnect the suction hose from the fuel pump.
(4) Remove the bottom cover-plate from the side-member.
(5) Extract the tank-retaining screw from the top face of the side-member.
(6) Remove the support bracket and lower the tank.

Refitting

(7) Reverse the removal instructions.

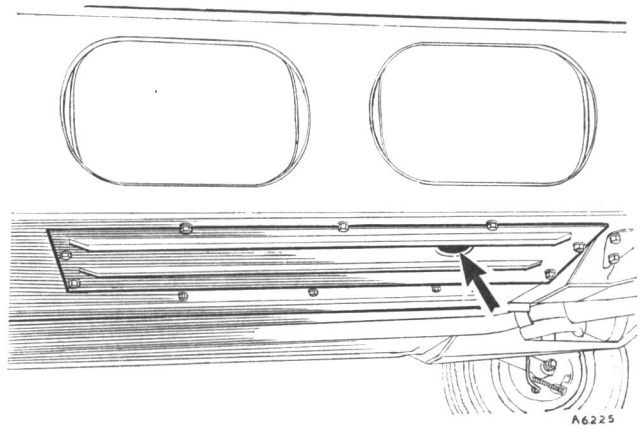


Fig. D.18
The fuel tank drain plug access

SECTION E

THE CLUTCH

Section

General description

Clutch

- Coil pressure spring type E.1
- Diaphragm type E.7

Clutch drag E.6

- Overthrow E.5
- Throw-out stop E.4

Master cylinder E.2

Slave cylinder E.3

Tools .. .. End of Section

GENERAL DESCRIPTION

The clutch is of the single-plate dry-disc type with the pressure and driven plates operating on the inner face of the flywheel. Lugs on the pressure plate extend through the flywheel and are secured to driving straps on the outer face of the flywheel and the pressure spring housing by three shouldered set pins. The driving straps are themselves anchored to the flywheel by three more shouldered set pins.

Six coil springs assembled in the housing pull the housing and pressure plate rearwards to keep the friction lining of the driven plate in contact with the inner face of the flywheel.

Disengagement is accomplished by moving the operating lever pressure pad forward against the thrust plate of the pressure spring housing; further pressure will then force the pressure plate away from the driven plate, which will in turn release itself from the flywheel and be permitted to revolve freely on the crankshaft.

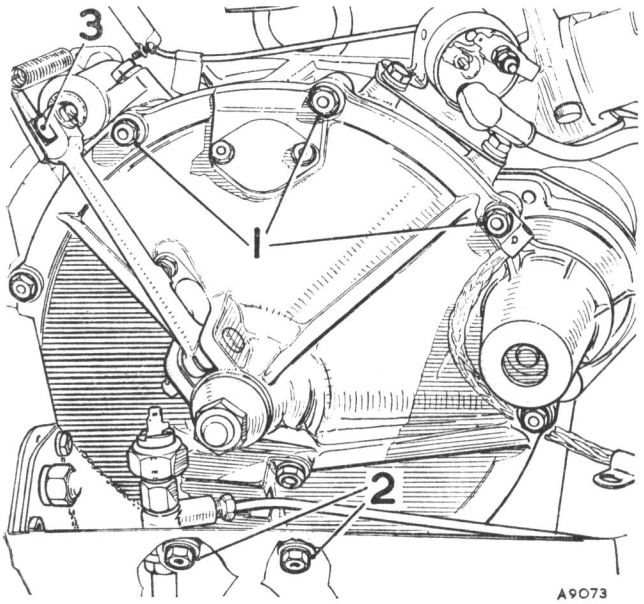


Fig. E.1

A view of the clutch cover

1. Three of the nine clutch cover set screws.
2. Engine mounting set screws.
3. Slave cylinder push-rod.

Section E.1

CLUTCH
(Coil Pressure Spring Type)

Remove the flywheel and clutch assembly as detailed in Section A.17.

NOTE.—The clutch to flywheel driving straps are laminated, i.e. two straps fitted to each of the three driving points. Mark all components, including both the straps and driving pins, before dismantling in order to identify them for refitting in their original positions.

Dismantling

The clutch pressure springs must be compressed in order that the spring housing can be released from the flywheel. Insert the three screws of Service tool set 18G 304 M through the three recessed holes in the spring housing, screw them fully into the flywheel, and screw the three nuts down finger tight against the housing. Tighten the nuts a turn at a time until the complete load is taken from the three flywheel to clutch driving pins. Remove the pins and gradually release the spring housing from compression until the springs are fully extended.

Examine and renew any worn parts, taking particular note of the pressure spring housing for signs of elongation in the driving pin holes. Should the shoulders of the driving pins show signs of wear or ridging, they must be replaced as a set of three and not as individual pins; this also applies to the three driving straps on the flywheel.

Reassembling

Reassembly is a reversal of the dismantling sequence, with particular attention given to the following points.

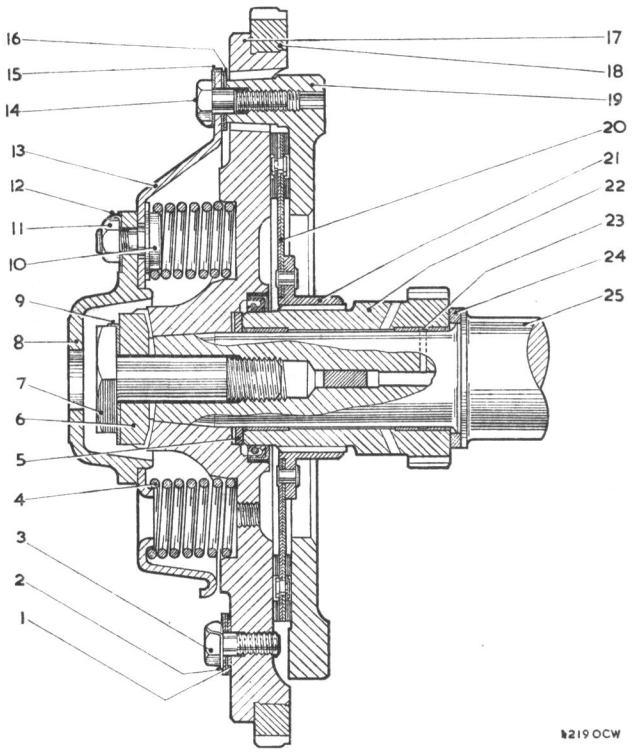


Fig. E.2

A section through the clutch assembly

1. Driving strap.
2. Lock washer.
3. Driving pin.
4. Pressure spring.
5. Circlip.
6. Keyed washer.
7. Flywheel screw.
8. Thrust plate.
9. Locking washer.
10. Pressure spring guides.
11. Guide nut.
12. Lock washer.
13. Pressure spring housing.
14. Driving pin.
15. Lock washer.
16. Driving strap.
17. Flywheel.
18. Starter ring.
19. Pressure plate.
20. Driven plate.
21. Driven plate hub.
22. Crankshaft primary gear.
23. Primary gear bearing.
14. Thrust washer.
25. Crankshaft.

Use Service tool 18G 571 to make certain that the hub of the driven plate is centralized with the hub of the flywheel, and remains so during assembly. Insert the tool through the hub of the driven plate and the bore of the flywheel, and secure it in position with the screw and retaining plate against the flywheel boss.

Ensure that the pressure spring locating guides are seating correctly in their slots in the spring housing. Make certain that all the components marked during the dismantling are refitted in their original positions.

When reassembling the clutch to the flywheel use Service tool 18G 304 M to compress the pressure springs. This tool will also ensure that the holes in the pressure spring housing and the driving straps are lined up with the tapped holes of the clutch pressure plate lugs. If these holes are not lined up correctly difficulty will be experienced when inserting the shouldered driving pins. Screw the driving pins into position, making certain that the shoulders of the driving pins are through the driving straps. Tighten up, and knock up the locking washers.

Make certain that two driving straps are fitted to each of the three driving points, at the same time ensuring that the straps and pins are returned to their original positions.

Should the driving strap be dismantled from the flywheel ensure that the spacing washer between the strap and flywheel is refitted on reassembly.

Refit the flywheel and clutch as in Section A.17.

Adjusting

It is important that a clearance exists between the clutch thrust race and the thrust ring. As wear takes place this clearance will diminish and, if neglected, clutch slip will result.

An adjustable stop is provided on the transmission casing just forward of the clutch operating lever. Pull the operating lever outwards until all free movement is taken up and then check with a feeler gauge that there is a clearance of ·060 in. (1·52 mm.) between the operating lever and the head of the adjustment bolt. Correct if necessary.

On later models with the shouldered stop the clearance must be ·020 in. (·50 mm.) (see Section E.4).

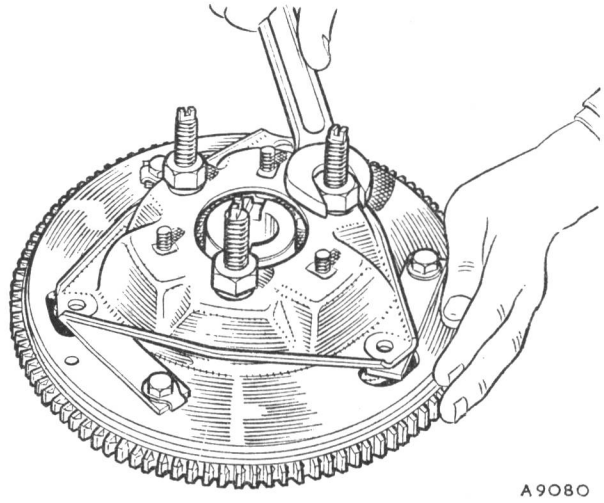


Fig. E.3

The clutch pressure springs being compressed with the aid of Service tool 18G 304 *M, with Service tool* 18G 571 *used to keep the driven plate and flywheel hubs centralized during the operation*

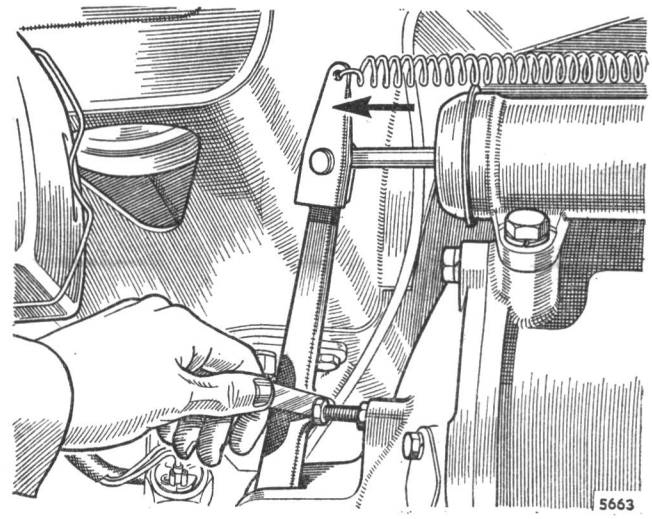


Fig. E.4

A clearance of ·060 *in.* (1·52 *mm.*) *or* ·020 *in.* (·50 *mm.*) *on later models must exist between the adjustable clutch return stop and the operating lever*

Section E.2

MASTER CYLINDER

Construction and operation

The master cylinder piston is backed by a rubber cup and is normally held in the 'off' position by a return spring. Immediately in front of the cup, when it is in the 'off' position, is a compensating orifice connecting the cylinder with the fluid supply. This port allows free compensation for any expansion or contraction of fluid, thus ensuring that the system is constantly filled; it also serves as a release for additional fluid drawn into the cylinder during clutch applications.

Pressure is applied to the piston by means of the push-rod attached to the clutch pedal.

The reduced skirt of the piston forms an annular space which is filled with fluid from the supply tank via the feed hole. Leakage of fluid from the open end of the cylinder is prevented by the secondary cup fitted to the flange end of the piston.

By releasing the clutch pedal after application the piston is returned quickly to its stop by the return spring, thus creating a vacuum in the cylinder; this vacuum causes the main cup to collapse and pass fluid through the small holes in the piston head from the annular space formed by the piston skirt. This additional fluid finds its way back to the reserve supply through the compensating orifice.

No pressure is maintained in the clutch line when the pressure is released.

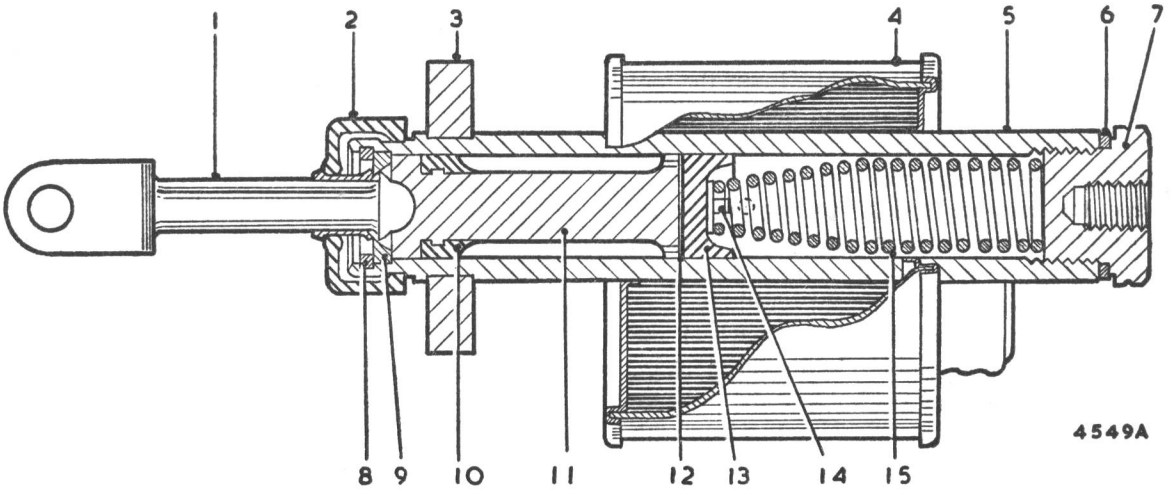


Fig. E.5

A section through the clutch master cylinder

1. Push-rod.
2. Rubber boot.
3. Mounting flange.
4. Supply tank.
5. Body.
6. Washer.
7. End plug.
8. Circlip.
9. Stop washer.
10. Secondary cup.
11. Piston.
12. Piston washer.
13. Main cup.
14. Spring retainer.
15. Return spring.

Removing

Remove the circlip and withdraw the clevis pin securing the master cylinder push-rod to the clutch pedal lever.

Disconnect the pressure pipe union from the cylinder, remove the two bolts securing the cylinder to the bulkhead, and withdraw the assembly complete from the car.

Dismantling

Remove the filler cap and drain out the fluid.

Pull back the rubber dust cover and remove the circlip with a pair of long-nosed pliers; the push-rod and dished washer can then be removed.

Withdraw the remaining parts shown in Fig. E.5 from the cylinder barrel.

To remove the secondary cup from the piston carefully stretch the cup over the end flange of the piston, using only the fingers.

Reassembling

Clean all parts thoroughly, using Lockheed Super Heavy Duty Brake Fluid for all rubber components. All traces of fuel (gasoline), paraffin (kerosene), or trichlorethylene used for cleaning the metal parts must be removed before assembly.

Examine all rubber parts for damage or distortion. It is usually advisable to renew the rubbers when rebuilding the cylinder. Dip all the internal parts in brake fluid and assemble them wet.

Stretch the secondary cup over the end flange of the piston with the lip of the cup facing towards the opposite end of the piston. When the cup is in its groove, work it round gently with the fingers to ensure correct seating.

Insert the return spring, largest-diameter coils first, into the barrel. Make sure the spring seat is positioned on the small-diameter end of the spring.

Insert the main cup, lip first, taking care not to damage or turn back the lip, and press it down onto the spring seat.

Insert the piston, taking care not to damage or turn back the lip of the secondary cup.

Push the piston down the bore, and replace the push-rod, retaining circlip, and rubber dust cover.

Test the master cylinder by filling the tank with fluid and pushing the piston down the bore and allowing it to return; after one or two applications fluid should flow from the outlet.

Refitting

Secure the master cylinder by means of the two bolts to the bulkhead cross-member. Refit the pressure pipe to the cylinder barrel.

Line up the push-rod yoke with the pedal lever and reconnect them with the clevis pin and retaining clip.

Refill the supply tank with Lockheed Super Heavy Duty Brake Fluid to within ¼ in. (6 mm.) of the filler neck and bleed the system as in Section E.3.

Section E.3

SLAVE CYLINDER

Removing

Attach a bleed tube to the nipple on the body of the slave cylinder and open the bleed screw three-quarters of a turn; pump the clutch pedal until all the fluid has been drained into a clean container.

Unscrew the pressure pipe from the cylinder, remove the two bolts securing the cylinder body to the clutch housing, and remove the clevis pin to release the cylinder push-rod from the clutch lever.

Dismantling

Clean the exterior of the assembly thoroughly before dismantling. Withdraw the push-rod and remove the rubber dust seal; use only the fingers to displace the seal retaining ring.

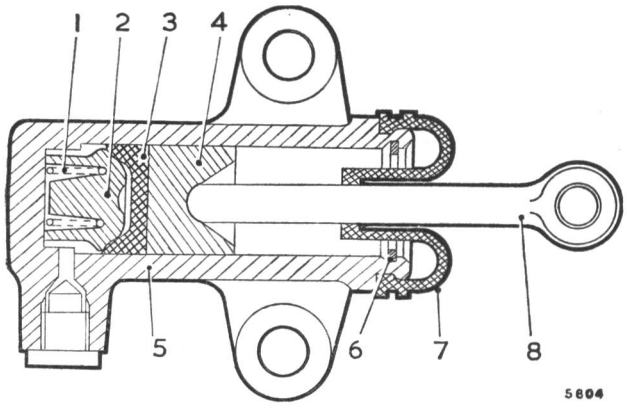


Fig. E.6

A section through a clutch slave cylinder

1. Spring.
2. Cup filler.
3. Cup.
4. Piston.
5. Body.
6. Circlip.
7. Rubber boot.
8. Push-rod.

Remove the retaining circlip; the piston, piston cup, cup filler, and the return spring can then be removed in that order.

Examine the parts, especially the seal, and renew them if they are worn or damaged; it is usually advisable to renew all rubber parts when rebuilding the cylinder.

Reassembling

Insert the return spring, largest-diameter coils first, into the barrel with the piston cup filler attached to the small-diameter end of the spring.

Replace the piston cup, lip first, taking care not to damage or turn back the lip, and press it down onto the cup filler.

Push the piston down the bore and refit the circlip. Replace the rubber dust seal, first making sure that the retaining ring is in position on the centre flange of the seal. Secure the seal to the cylinder body with the large steel retaining ring.

Replace the operating plunger.

Refitting

Refitting is a reversal of the removal procedure, but the system must be bled to expel any air from the fluid lines.

Bleeding

Fill the master cylinder reservoir to the correct level with the recommended fluid and attach a rubber tube to the slave cylinder bleed valve; immerse the open end of the tube in a clean receptacle containing a small amount of fluid. With a second operator to pump the clutch pedal, open the bleed screw on the slave cylinder approximately three-quarters of a turn; at the end of the down stroke on the clutch pedal close the bleed screw before allowing the pedal to return to the 'off' position.

Continue this series of operations until clear fluid free from air bubbles is delivered into the container.

Ensure that the fluid level is maintained in the reservoir throughout the operation.

Section E.4

CLUTCH THROW-OUT STOP

On later models a shouldered stop is fitted to the clutch throw-out plunger operating against the central boss of the clutch cover. This stop is set and locked in its correct position during initial assembly and should not be disturbed during normal servicing. Clutch free pedal adjustment is only undertaken at the lever stop screw as detailed in Section E.1. If it is found necessary to remove the throw-out plunger during overhaul the stop must be reset. Screw the stop and locknut away from the cover boss to the limit of its travel. Depress the clutch pedal to fully release the clutch, hold it in this position and screw the stop up against the cover boss, release the clutch pedal to fully engage the clutch, screw the stop up a further ·007 to ·010 in. (·178 to ·254 mm.) (equivalent to approximately one flat of the hexagon locknut), and fully tighten the locknut.

Re-check the clearance at the lever stop screw, and adjust to ·020 in. (·50 mm.) if necessary.

Section E.5

CLUTCH OVERTHROW

The design of the clutch calls for only sufficient movement of the clutch mechanism to free the driven plate. Should overthrow of the clutch occur, the excess movement will impose a load on the crankshaft thrust washers far beyond that for which they were designed. This overload will certainly cause abnormal wear of the thrust washers, and may result in their complete disintegration, with serious damage to the transmission from the particles of metal thus introduced.

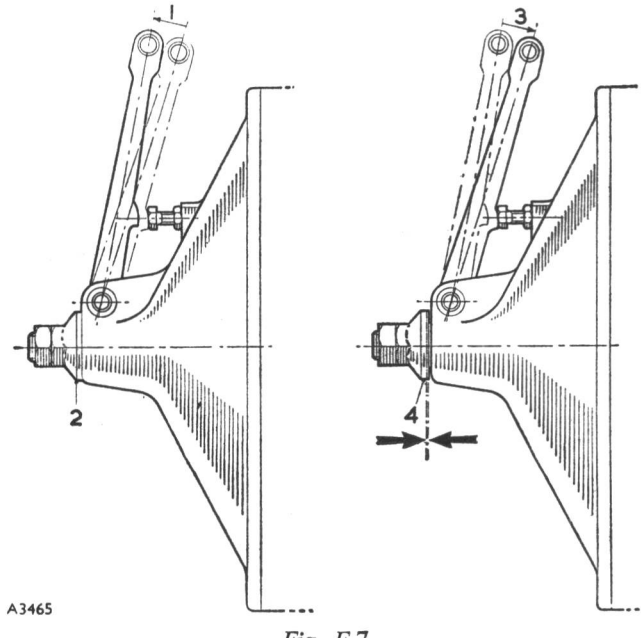


Fig. E.7

(1) *The clutch fully released, with* (2) *the throw-out stop screwed up to the cover boss.* (3) *The clutch fully engaged and the stop* (4) *screwed up a further* ·007 *to* ·010 *in.* (·178 *to* ·254 *mm.*) *towards the cover boss*

The amount of throw is controlled under normal circumstances by the clearance between the clutch operating lever and the adjustable clutch return stop (Fig. E.4).

There are, however, two conditions in which overthrow of the clutch can take place, even though the clearance between the clutch operating lever and the clutch return stop is correct, i.e. (1) stiffness of operation in the operating mechanism preventing the operating lever from returning fully, or (2) incorrect clutch pressure springs becoming coil-bound.

To test for clutch overthrow, warm up the engine to its normal running temperature and allow it to tick over at a speed not exceeding 500 r.p.m.

Depress the clutch pedal fully and release it normally, repeating this action three or four times without pause. If the engine slows down appreciably or stalls, clutch overthrow is occurring.

In this case proceed as follows.

Check the external operating mechanism for stiffness of operation, and rectify where necessary. Fit a stronger operating lever return spring (Part No. 1G 5999); the fitting of the stronger spring and the rectification of any stiffness will almost certainly overcome any tendency to clutch overthrow from stiffness of operation (1).

Repeat the test for stalling, and if a cure has not been effected the clutch pressure springs must be suspected (2).

Increase the clearance between the operating lever and the return stop to a maximum of ·075 in. (1·91 mm.) and re-test.

If this adjustment is of no avail the clutch must be dismantled (Section E.1) and a new set of correct pressure springs fitted.

Section E.6

CLUTCH DRAG

Because of the type of clutch layout, cold and congealed oil between the crankshaft primary gear bushes and the crankshaft in vehicles fitted with lubricated primary gear bushes can create a condition of clutch drag.

Movement between these components will restore normal conditions; therefore, if clutch drag is experienced, hold the car at rest in gear with the clutch released and the engine running for several seconds.

If the clutch drag still persists after this operation check for the following faults:

Air in the hydraulic operating system.

Incorrect adjustment of the operating lever stop.

Excessive crankshaft end-float.

Flywheel oil seal displaced.

If air is present in the hydraulic system, check for leakage of fluid and ingress of air, and rectify as necessary. Bleed the system thoroughly as described in Section E.3. Check the clearance at the operating lever stop (Fig. E.4), and adjust as necessary; crankshaft end-float must be taken into account when setting this clearance.

Measure the crankshaft end-float externally by mounting a clock gauge at the pulley end of the shaft. Prise the crankshaft in the direction of the flywheel and set the gauge at zero. Disengage the clutch by operating the clutch pedal and observe the reading on the gauge. Should this reading indicate an excessive crankshaft end-float, attention must be given to the crankshaft thrust washers.

When adjusting the clearance at the clutch operating lever stop the crankshaft must be held in its most forward position, i.e. away from the clutch.

If a damaged flywheel oil seal is suspected the clutch must be dismantled and the condition of the oil seal inspected.

If a new seal is necessary ensure that the replacement seal is of the type with a metal outer case. Coat the bore of the seal housing with jointing compound before fitting the oil seal but ensure that the jointing compound is confined to the seal housing only.

Section E.7

CLUTCH

(Diaphragm Spring Type)

A diaphragm spring replaces the six conventional coil pressure springs on this clutch assembly.

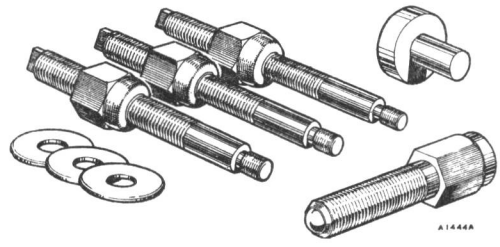
Remove and refit the flywheel and clutch as detailed in Section A.39.

SERVICE TOOLS

18G 304 M. Flywheel and Clutch Remover Adaptors

A set of four screws, three designed to screw into the flywheel and hold the clutch cover and pressure springs under compression in order to dismantle and reassemble the clutch. The fourth screw is used to replace the centre screw of the removing tool 18G 304 when the tool is used to remove the clutch and flywheel from the crankshaft.

Do not use the three black adaptor screws on cars fitted with a diaphragm spring clutch.

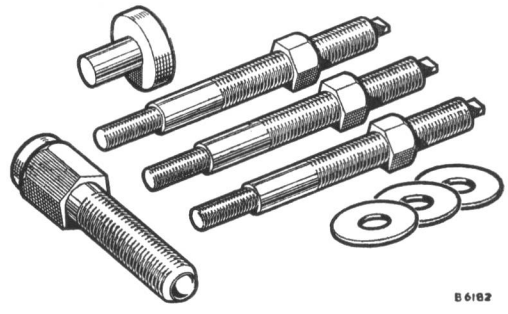


18G 304 M

18G 304 N. Flywheel and Clutch Remover Adaptors

A set of adaptors which must be used when pulling a flywheel fitted with a diaphragm clutch. Use with tool 18G 304.

Do not use these adaptor screws on cars fitted with coil pressure spring clutch assemblies.

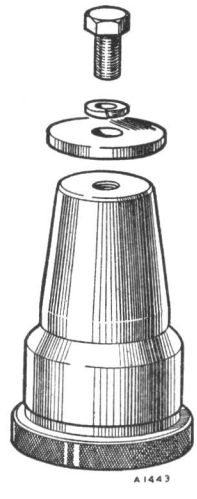


18G 304 N

18G 571 and 18G 684. Clutch Centralizer

The use of this tool will ensure that the clutch pressure plate and the flywheel remain centralized throughout the reassembly operation. Insert the tapered centralizer through the hub of the clutch plate and the bore of the flywheel, and secure it firmly in position with its retaining plate, spring washer, and set screw.

Use 18G 684 to centralize the clutch pressure plate and the flywheel on the Mini-Cooper.



18G 571

SECTION F

THE TRANSMISSION

	Section
Differential assembly	F.4
Gear synchronizing cones (non-baulk-ring transmission)	F.5
Service tools	End of Section
Third motion shaft	F.3
Baulk-ring synchromesh	F.6
Transmission	
Dismantling	F.1
Reassembling	F.2

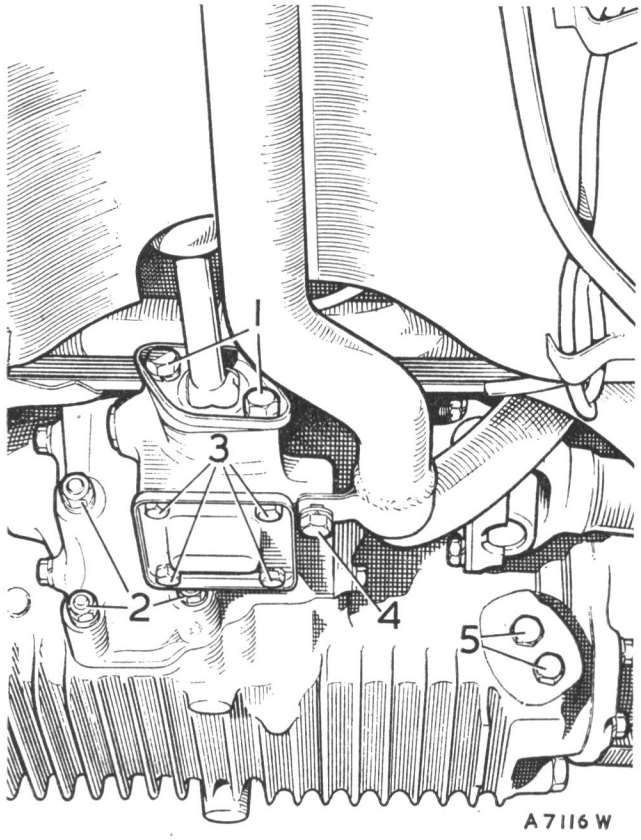


Fig. F.1
The rear of the transmission assembly from beneath the car

1. Change speed lever retaining screws.
2. Three of the four differential stud nuts.
3. Extension cover-plate screws.
4. Exhaust pipe front fixing point.
5. Plugs, interlocking plungers, and spring.

NOTE

A list of Service tools necessary when dismantling or reassembling the transmission is shown at the end of Section F.

Section F.1

DISMANTLING THE TRANSMISSION

Remove the transmission casing from the crankcase as detailed in Section A.23.

Remove the idler gear from the crankcase. Note the thrust washers fitted each side of the gear. Use Service tool 18G 581 to remove the idler gear bearings.

Remove the differential assembly as in Section F.4.

Remove the change speed reverse detent plunger plug and withdraw the spring and plunger.

Remove the clamp screw from the selector lever and withdraw the gear change operating shaft, taking care not to damage the oil seal in the transmission casing with the Woodruff key fitted to the lower end of the shaft.

Unscrew the speedometer pinion housing screw, remove the housing, and withdraw the pinion. Take out the two set screws and remove the speedometer gear retaining plate from the transmission case front cover; withdraw the speedometer gear.

Remove the nine set screws and take off the transmission casing end cover.

Remove the screw securing the oil suction pipe bracket to the lug on the transmission casing, and the two screws through the pipe flange and the external blanking plate. Withdraw the pipe from the strainer. Note the paper joint washer fitted between the pipe flange and blanking plate and the casing.

Unscrew and remove the set pins and locking plate securing the third motion shaft bearing retainer to the centre web of the casing and extract the retainer together with the packing shims.

Remove the third motion shaft drive pinion nut, locking washer, and the drive pinion.

Remove the circlip and roller bearing from the end of the first motion shaft, knock up the locking washer and remove the nut from the end of the shaft, and withdraw the first motion shaft driving gear.

Remove the lay and reverse shaft locking plates, push the layshaft out of the casing, and remove the laygear and thrust washers.

Remove the screwed retaining plugs from the outside of the casing and extract the selector rod interlocking plungers and spring.

Extract the first motion shaft bearing circlip and carefully withdraw the bearing from the casing, using Service tool 18G 284 with adaptor 18G 284 B.

Unlock the first and second speed selector fork, withdraw the fork rod, and extract the selector fork from the casing.

To remove the third motion shaft bearing carefully drift the third motion shaft rearwards until Service tool 18G 613 can be interposed between the first speed gear hub and the bearing. The recessed face of the tool must be towards the bearing. Carefully drift the third motion shaft forward until the bearing is practically out of its housing. The bearing can then be gently levered off the shaft and out of its housing.

Extra care must be taken when drifting the third motion shaft forward not to damage the selector forks. With the bearing withdrawn the third motion shaft can be removed from the casing.

Unscrew and remove the remaining oil strainer bracket screw and locking plate and withdraw the strainer assembly.

Release the locknut and slacken off the third and fourth gear selector fork locating set screw. Withdraw the selector rod and remove the fork from the casing.

Remove the reverse gear shaft, gear, and selector fork, and extract the detent spring and plunger.

Release the circlip from the reverse gear shifter lever pivot pin and remove the lever.

Section F.2

REASSEMBLING THE TRANSMISSION

Press the reverse gear shifter lever pivot pin into its drilling in the bottom of the transmission casing; fit the shifter lever and secure it to the pivot with a circlip.

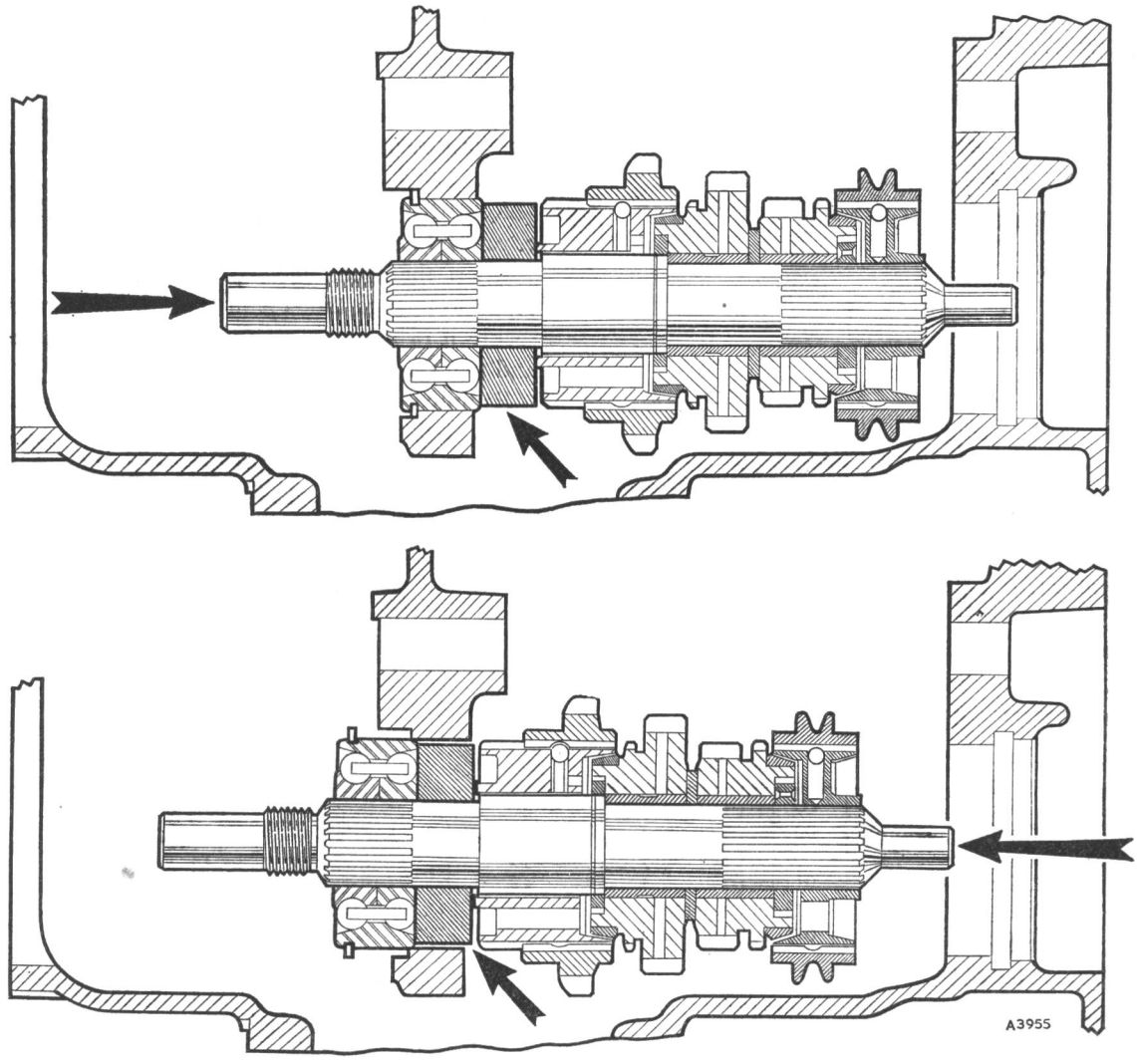


Fig. F.2

Showing the method of removing the third motion shaft bearing, using Service tool 18G 613

Place the reverse gear and gear fork in position to engage the reverse shifter lever and push the reverse gear shaft through the centre web of the casing into the gear, plain end foremost, leaving the slotted end exposed.

Insert the reverse selector rod interlock spring and plunger. Push the reverse selector rod into the casing from the front to pick up the reverse gear fork on the way through.

Position the third and fourth gear selector fork in the casing and push the selector rod through from the front to pick up the fork on the way through. Screw in the selector fork set screws to engage the indentations on the selector rods; tighten up and secure with the locking nuts.

Place the pick-up strainer in the casing and insert the fixing screws through the strainer bracket and the lug in the casing, leaving the nuts slack on the screws. Smear a small quantity of grease on the sealing ring fitted between the bracket and the strainer; this will help the oil suction pipe to pass through and not push the seal out when it is fitted.

Take the third motion shaft assembly and place it in the casing with the slotted end passing through the centre web of the casing, and with the first and second sliding hubs engaging the selector forks.

Place the ball race on the first motion shaft and insert the assembly into the casing. Position the third motion shaft bearing in the centre web of the casing; make certain that both the first and third motion shafts line up, and carefully drift both the bearings into position. Use Service tool 18G 579, together with the distance collar, to drift the third motion shaft bearing into the centre web of the casing. The collar must be placed in the recess on the end of the tool in order that the outer race will be driven into the casing at the same time as the inner race is driven onto the third motion shaft. The same tool is used to drift the first motion shaft bearing into the casing; in this case the distance collar is not used. Fit the first motion shaft bearing retaining circlip (see Fig. F.4).

Refit the first and second gear selector fork and fork rod and secure the fork with its locating screw and locking nut.

Refit the first and second, third and top selector rod detent plungers and springs, not forgetting the sealing washers to fit under the head of the screwed retaining plugs.

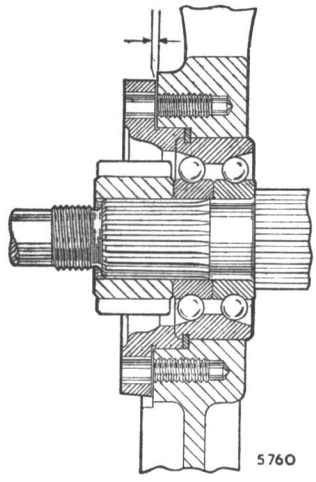


Fig. F.3

A section through the third motion shaft bearing and bearing retainer. It is essential that the correct thickness of shim is used to take up the gap indicated in the illustration. Use the following table to ensure that the correct shim thickness is used

When the gap is	*Use shims totalling*
·005 to ·006 in. (·127 to ·152 mm.)	·005 in. (·127 mm.)
·006 to ·008 in. (·152 to ·203 mm.)	·007 in. (·178 mm.)
·008 to ·010 in. (·203 to ·254 mm.)	·009 in. (·229 mm.)
·010 to ·012 in. (·254 to ·304 mm.)	·011 in. (·279 mm.)
·012 to ·014 in. (·304 to ·256 mm.)	·013 in. (·330 mm.)
·014 to ·015 in. (·356 to ·381 mm.)	·015 in. (·381 mm.)

Replace the drive pinion, locking washers, and nut on the front end of the third motion shaft; tighten the pinion nut, and bend over the locking washer.

Refit the first motion shaft driving gear, ensuring that the locating pegs on the locking washer are engaged in the two holes in the gear; tighten up the nut and bend up the washer.

Refit the laygear with a thrust washer at each end and with the slotted end of the shaft to the front. Use Service tool 18G 471 to retain the thrust washers in position when the layshaft is being fitted. There must be an end-clearance of between ·002 and ·006 in. (·051 and ·152 mm.) when the laygear and thrust washer are fitted; thrust washers ranging in size from ·123 to ·131 in. (3·12 to 3·32 mm.) are available to enable this clearance to be obtained. Turn the layshaft and reverse shaft to line up the slotted ends; the slots must face each other to enable the shaft locating plate to be refitted. Replace the third motion shaft bearing retainer, fitting shims as necessary (see Fig. F.3) to take up the area between the bearing outer race and the retainer. Note that the shims must be positioned underneath the reverse shaft and layshaft locating plate. Secure in position with four set screws and the lock plates.

Remove the front screw of the two holding the pick-up filter bracket and insert the oil suction pipe into the filter, taking care not to push the sealing rubber between the strainer and strainer bracket out of position; lightly grease the seal before inserting the pipe. Replace the two paper gaskets between the pipe flange, the outer blanking plate, and the casing; insert and tighten up the two set screws. Replace the strainer bracket screw to secure the oil pipe support bracket, replace the locking plate, and tighten down both bracket screws; bend up the locking plate.

Refit the selector interlocking arm and the front end cover and gasket.

Insert the speedometer drive gear through the front cover to engage the slot in the third motion shaft, and secure it in position with the cover-plate, paper gasket, and two set screws.

Examine the seal in the pinion shaft housing, and renew it if necessary. Replace the paper gasket, should it be damaged; push the housing carefully over the pinion shaft and secure it with the one set screw.

Insert the gear change operating shaft into the casing, taking care not to damage the oil seal in the casing with

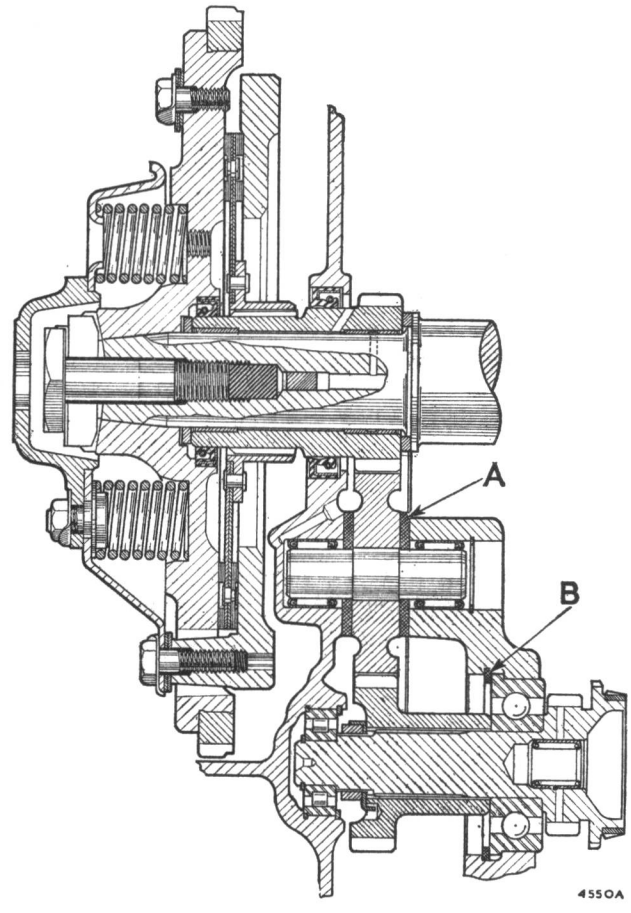


Fig. F.4

A section through the idler gear and the first motion shaft

A. The idler gear must have from ·003 to ·008 in. (·076 to ·20 mm.) end-float.

B. Take the measurement between the first motion shaft bearing face and the bearing register. Use Service tool 18G 569 for this purpose.

For measurements (B)	*Use circlip Part No.*
·096 to ·098 in. (2·43 to 2·48 mm.)	2A 3710
·099 to ·100 in. (2·51 to 2·54 mm.)	2A 3711

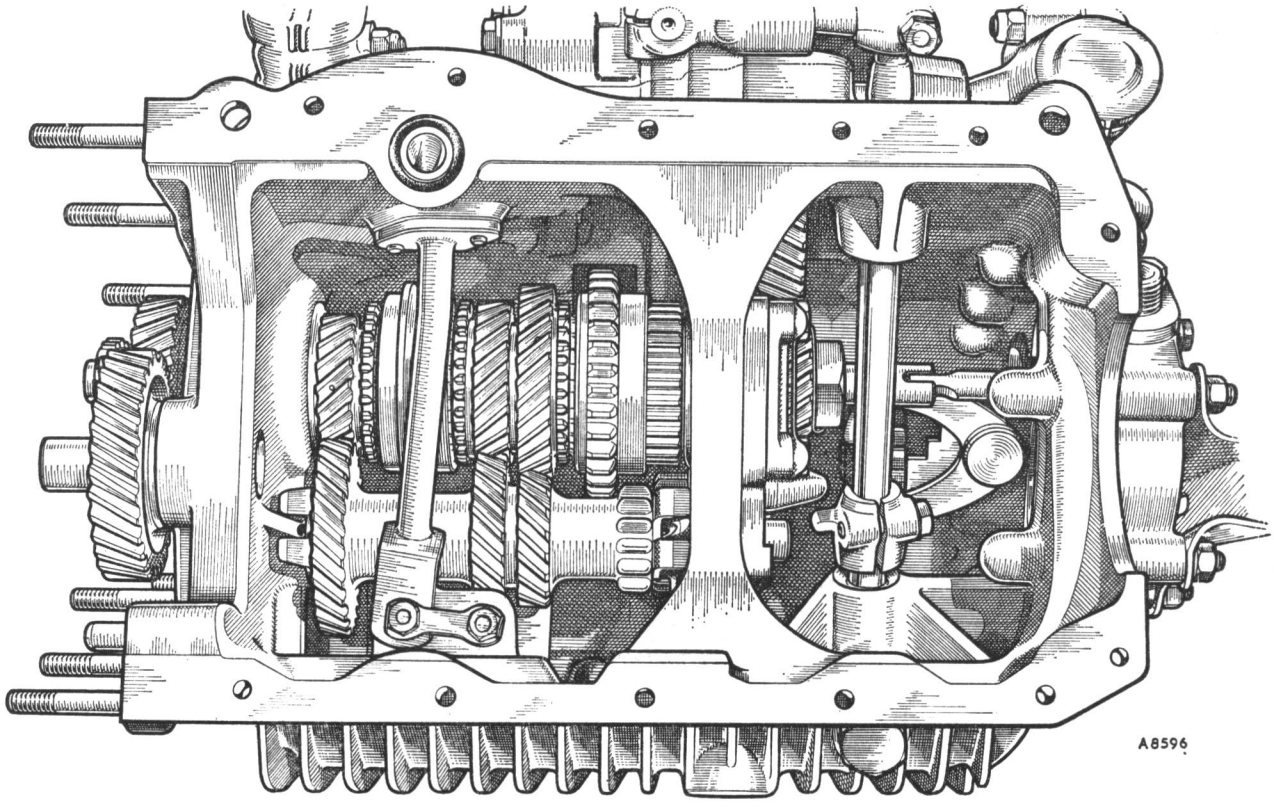


Fig. F.5

A view of the transmission assembly with all the gears assembled into the casing

the Woodruff key fitted in the lower half of the shaft. Should it be necessary to replace the oil seal, use Service tool 18G 573 to drift the new seal into position. Position the selector lever inside the casing with the end engaged in the interlocking arm and push the shaft through the lever boss into its lower bearing point in the casing. Line up the recess in the shaft with the drilling through the lever boss, insert and tighten the set screw, and bend up the locking washer.

Refit the gear change operating shaft reverse detent plunger, spring, and plug.

Refit the differential assembly as in Section F.4.

Should the idler gear bearing in the flywheel casing require renewing, the area round the bearing boss must be well supported during the pressing-in operation.

Use Service tool 18G 582 to refit the idler gear bearing to both the flywheel housing and the transmission casing. The collar supplied with this tool must be used to control the depth to which the bearing is pressed into the flywheel housing. Should the bearing be pressed in to the full depth of the bearing bore, it would mask the oil supply hole. The collar is not required when refitting the idler gear bearing to the transmission casing.

Replace the idler gear with a thrust washer on either side of the gear and fit the washers with the chamfered bore against the gear face. Refit the roller bearing on the end of the first motion shaft and fit the flywheel housing and gasket to the transmission casing.

With the housing nuts tightened up there should be between ·003 and ·008 in. (·076 and ·203 mm.) end-float on the idler gear. Thrust washers ranging in thickness from ·132 to ·139 in. (·8 to 1 mm.) are available for this purpose. Remove the housing and gasket.

Refit the transmission case assembly to the crankcase as detailed in Section A.23.

Section F.3

THIRD MOTION SHAFT

Remove the shaft assembly from the transmission casing as detailed in Section F.1.

Dismantling

Withdraw the top and third gear synchromesh hub from the forward end of the shaft, observing that the plain side of the hub faces to the rear of the gearbox.

Remove the front thrust washer by pressing down the spring-loaded locating plunger and rotating the washer until the splines register with those on the shaft. Withdraw the thrust washer and gear. Take out the plunger and spring and withdraw the third gear bush and interlocking ring. Withdraw the second speed gear and bush. Remove the rear thrust washer and the first speed gear and hub.

If it is necessary to separate the second or third and fourth speed striking dog from the synchromesh hub and cone assemblies the assembly should be wrapped in a suitable piece of cloth in order to retain the three balls and springs which are located in each hub.

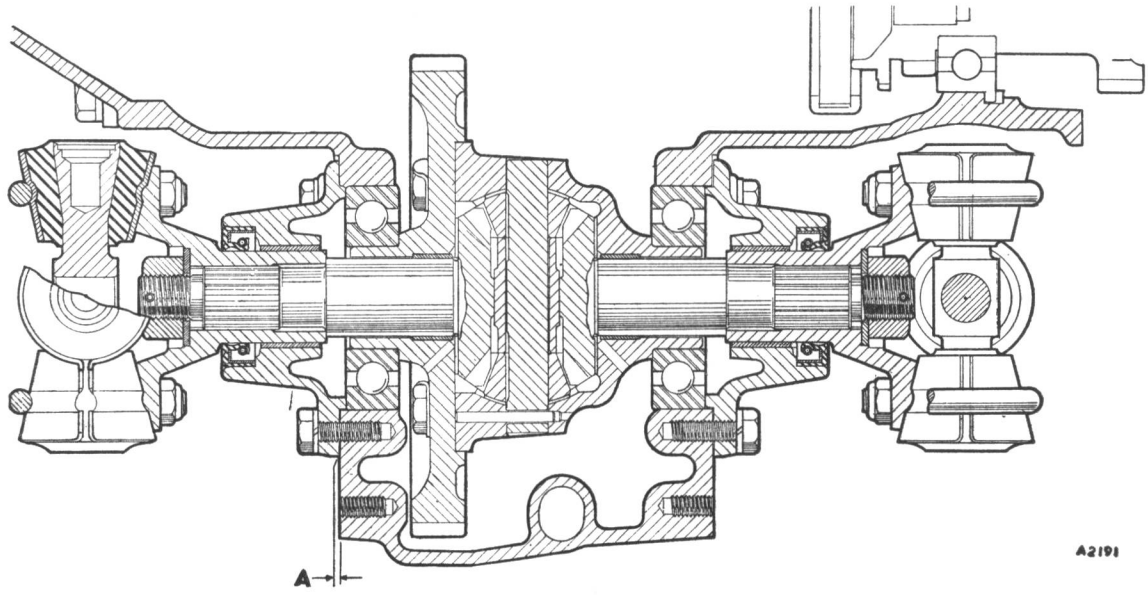


Fig. F.6

A section through the differential assembly and final drive end covers. In order to obtain the correct preload on the differential bearings a feeler gauge measurement must be taken at point (A), *indicated in the above illustration with the left-hand final drive cover fitted without its joint washer*

Reassembling

When assembling the first and second speed hub ensure that the cone side of the hub is on the same side of the assembly as the plain side of the first gear teeth.

Reassembly of the mainshaft is a reversal of the dismantling procedure.

The first and second speed hub is fitted with the cone side away from the bearing position and is followed by the rear thrust washer and the plain half of the split bush, with the plain end against the thrust washer. Follow this with the second speed gear, the interlocking ring, and the splined half of the centre bush, engaging the dogs of each half-bush with the central interlocking ring.

The essential interference fit of the bushes will have been destroyed when they were removed, and new bushes must be fitted during reassembly. Heat the bushes to a temperature of 180 to 200° C. (356 to 392° F.); expansion will then allow them to be fitted without force and subsequent natural cooling will establish a permanent 'shrink fit'. Carefully position the third speed gear, plain side first, and insert the spring and locking plunger. Depress the plunger and push the thrust washer in position above the plunger. Turn the thrust washer until the plunger engages the spline and locks the washer.

The end-float of the second and third speed gear when assembled on the third motion shaft must be between ·0035 and ·0055 in. (·09 and ·12 mm.).

Refit the top and third speed synchromesh hub, plain side towards the retaining thrust washer.

Refit the first and second speed hub and ensure that the cone side of the hub is on the same side of the assembly as the plain side of the first gear teeth.

Refit the assembly as detailed in Section F.2.

Section F.4

DIFFERENTIAL ASSEMBLY

Removing

Remove the engine as detailed in Section A.34.

Remove the transmission as detailed in Section A.23.

Unscrew the hexagon cap and remove the change speed lever anti-rattle spring and plunger from the gear change extension.

Take out the four set screws and remove the bottom cover-plate from the gear change extension. Remove the clamp screw securing the lever to the top of the remote-control shaft and withdraw the shaft. Remove the nylon seating and tension spring from both the remote-control shaft and the shaft lever.

NOTE.—The fitting of a nylon seating and tension spring in the cup of the remote-control shaft lever was discontinued on later engines to give more freedom of movement to the shifter lever, and they should be discarded when removed from the earlier engines during overhaul.

Extract the split pin from the slotted nuts securing both right- and left-hand driving flanges to the differential gear shafts, remove the nuts using Service tool 18G 669 to hold each driving flange in turn, and withdraw the flanges.

Do not under any circumstances use the transmission casing as a stop or leverage point when removing the driving flange nuts or other components of the transmission. Serious damage to the casing can easily result from misuse in this way.

Unscrew the five set screws from each of the final drive end covers and remove the covers from the differential housing. Note the number of shims fitted between the differential bearing and the housing.

Remove the differential housing stud nuts, withdraw the housing from the transmission case, and remove the differential assembly.

Dismantling

Withdraw the two differential bearings, using Service tool 18G 2. Knock back the locking plate tabs and remove the six set bolts securing the driving gear to the cage.

Mark the gear and cage to assist in refitting them in their original positions. Separate the gear from the cage and extract the differential gear and thrust washer from the bore of the driving gear. Tap out the taper pin to release both of the pinions and thrust washers, pinion spacer, and the other differential gear and washer. The taper pin cannot be removed until the cage and driving gear are separated. On later models knurled oil grooves have been introduced to improve the lubrication between the pinions and the pinion spacer.

Reassembling

Reassembly is a reversal of the dismantling procedure; make sure, however, that the differential gear thrust washers are replaced with their slightly chamfered bores against the machined face of the differential gears. It is essential that all component parts are replaced in their original positions.

Refitting

Place the differential assembly in the transmission casing with a slight bias towards the flywheel end of the engine. Refit the differential housing with its joint washers, tightening up the nuts sufficiently only to hold the bearings firmly and yet still allow the assembly to be displaced by the fitting of the right-hand final drive end cover.

Refit the right-hand drive end cover together with its joint washer. Make certain that the holes in the cover flange and the tapped hole in the transmission casing and differential housing are correctly lined up, insert the set screws, and tighten them up carefully and evenly to ensure maximum contact between the register on the inner face of the cover and the differential bearing outer race. As the screws are tightened up the differential assembly will be displaced away from the flywheel side of the engine.

Fit the left-hand final drive cover without its joint washer.

As the cover flange will not have the support of the joint washer tighten up the set screws sufficiently only for the cover register to nip the bearing outer race; overtightening will distort the cover flange. Take a feeler gauge measurement between the cover flange and the differential housing and transmission casing. This measurement must be taken in more than one position; variations in measurement will indicate that the set screws have not been tightened up evenly, resulting in the differential assembly being pulled out of alignment. Adjust the tension on the cover set screws accordingly, at the same time avoiding excessive tension being placed upon the cover flange, and measure again with the feeler gauge. If a feeler gauge cannot be inserted between the cover flange and the housing, shims to the value of ·008 in. (·203 mm.) must be fitted between the bearing outer race and the register on the end cover.

The compressed thickness of the cover joint washer is ·007 in. (·178 mm.) and the required preload on the bearings is ·001 to ·002 in. (·025 to ·051 mm.). The correct gap is, therefore, ·008 to ·009 in. (·203 to ·229 mm.). Any deviation from this figure must be made up by shimming; for example, if the gap as measured by the feeler gauge is ·005 in. (·127 mm.) a shim of ·003 in. (·076 mm.) thickness must be added between the bearing and the register on the inner face of the end cover.

Remove the end cover and refit the joint washer and shims to the dimensions as found necessary by the above procedure, and tighten up the cover screws.

Tighten up the differential housing nuts; refit the driving flanges to the differential gear shafts and secure them with the slotted nuts and split cotter pins.

When servicing a differential unit operators must make certain that the drive shafts are equally free to rotate on both sides, as tightness on either one would tend to make the vehicle's steering pull one way or the other.

Fit the operating lever to the splined end of the gear change operating shaft; make certain that the recess in the shaft is correctly lined up with the drilling in the boss of the lever before inserting the set screw. Position the remote-control shaft lever on the ball end of the operating lever, insert the remote-control shaft into the gear change extension from the bottom, to engage and enter the splined bore of the lever.

NOTE.—Do not refit the nylon seating and tension spring to the cup of the remote-control shaft lever, they should be discarded. Make certain that the recess in the splined end of the shaft is lined up with the drilling in the lever boss before attempting to insert the set screw.

Fit the tension spring and nylon seating to the operating shaft cup and refit the change speed lever, securing it in position with the retaining cover and two set screws, plus any packing removed during dismantling. Insert the anti-rattle plunger and spring and secure in position. Replace the bottom cover-plate.

Section F.5

GEAR SYNCHRONIZING CONES

(Non-baulk-ring Transmission)

These cones are 'shrunk on' to the second, third, and fourth speed gears and are normally supplied as a complete unit for spares purposes. Where facilities exist for shrinking on and finally machining the cones, they can be supplied separately. If the gear is to operate satisfactorily, however, care must be taken in fitting them.

The internal machining of the cone is calculated to allow for a shrinkage fit onto the gear, and the cone must be heat-expanded before it can be fitted.

When heated in oil to approximately 121·1° C. (250° F.) expansion will allow the cone to be pressed home onto the gear without damage.

NOTE.—The six large recesses on the perimeter of the cone must line up with the holes in the boss of the gear.

After shrinking on, the unit should be immediately quenched in water to prevent the gear itself being softened. Punch-mark the cone in each of the six recesses. This ensures resistance to displacement when changing gear.

When the cone is in position the final machining can be done in accordance with the dimensions given in Fig. F.7.

Section F.6

THIRD MOTION SHAFT
(Baulk-ring Synchromesh)

Later vehicles have baulk-ring synchromesh fitted to the transmission. The dismantling and reassembling sequences are the same as detailed in Section F.3, except that the second and third/top gear synchronizers are fitted with baulk-rings.

NOTE.—Should the first and second speed gear assembly have been dismantled, the correct position of the gear on the hub when reassembling is most important. If the gear is incorrectly assembled on the hub, selection of first gear will be impossible.

When reassembling the gear to the hub ensure that the plunger in the hub aligns with the cutaway tooth in the gear assembly (see Fig. F.8).

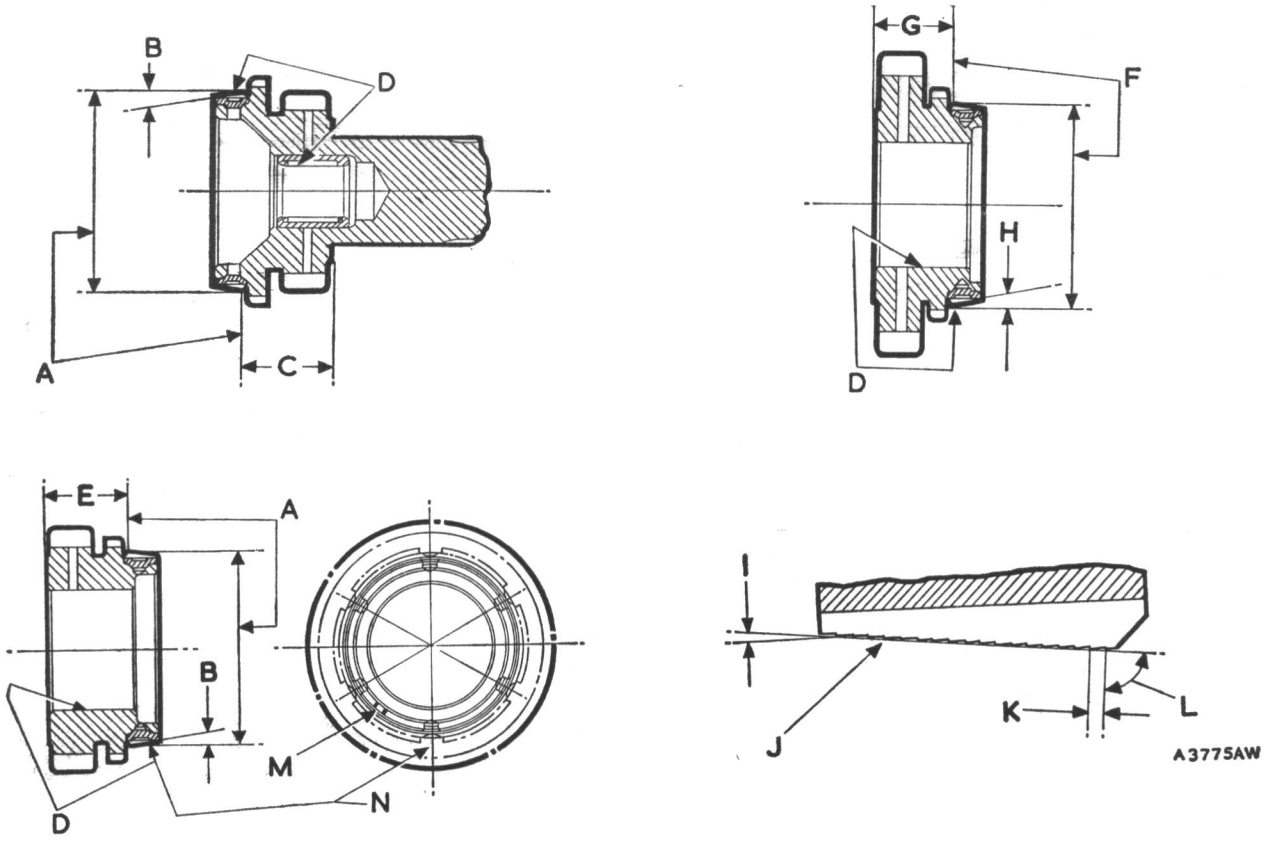


Fig. F.7

Top left: first motion shaft. Lower left: third speed mainshaft gear. Top right: second speed mainshaft gear. Lower right: Cone

Dimensions

A. Taper 2·150 in. (54·61 mm.) dia. at this line to gauge.

B. Taper 10° 30′, to be true and concentric with bore to ·001 in. (·025 mm.).

C. ·909/·912 in. (23·09/23·16 mm.).

D. Taper to be true and concentric with bore to ·001 in. (·025 mm.).

E. ·862/·865 in. (21·8/21·9 mm.).

F. Taper 2·150 in. (54·61 mm.) dia. at this line to gauge.

G. ·837/·840 in. (21·254/21·335 mm.).

H. 8° 30′.

I. 6°.

J. Coarse turning may be either right or left hand.

K. ·015 in. (·38 mm.).

L. 90°.

M. One notch to be ground in position shown relative to grooves with indentations.

N. Synchronizing cone to be heated in oil, shrunk onto gear, and punched into holes as shown with centre-line of holes and spaces in cone in line.

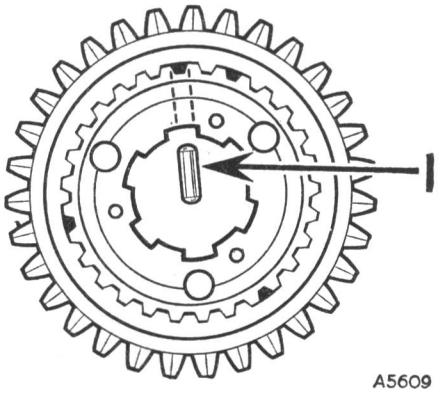


Fig. F.8

The first and second speed gear assembly, showing the gear and hub correctly assembled. The plunger is shown at (1)

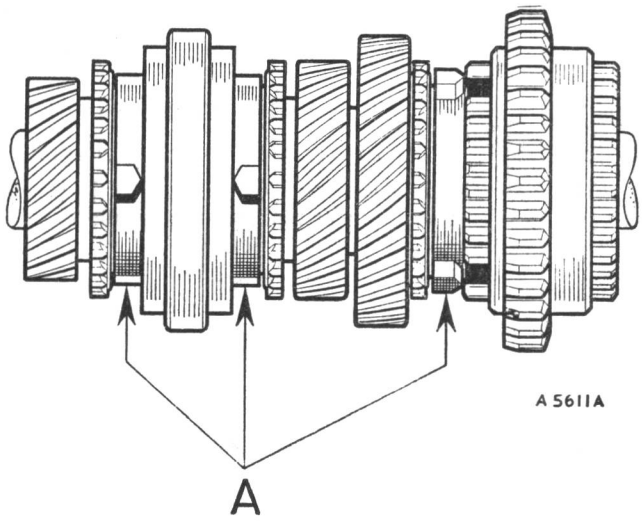


Fig. F.9

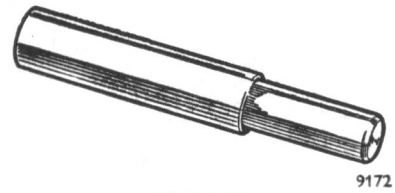
The third motion shaft assembly, showing the position of the baulk-rings (A)

(*For* **'SERVICE TOOLS'** ***see page F.10***)

SERVICE TOOLS

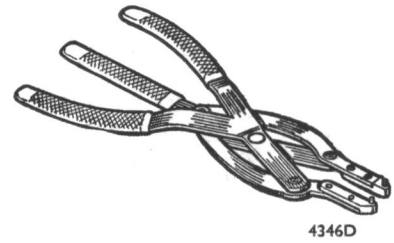
18G 194. Laygear Needle-roller Bearing Replacer

The fitting of needle-roller bearings in the laygear is made considerably easier by the use of this tool. It can also be used to refit the bearing retaining spring ring.



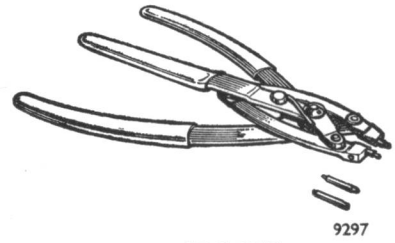
18G 194

18G 1004. Circlip Pliers



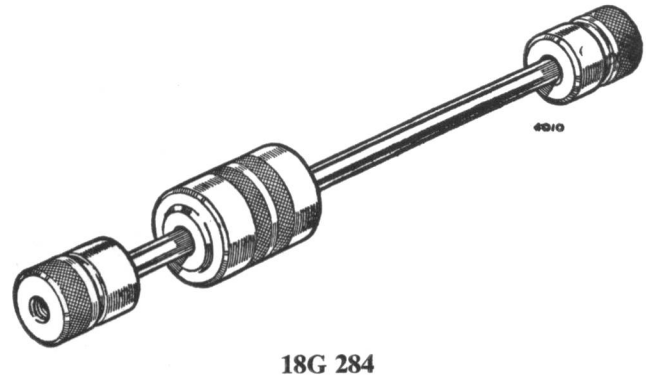
18G 1004

18G 257. Circlip Pliers—Large



18G 257

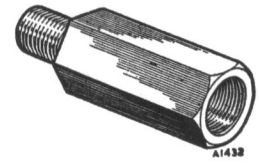
18G 284. Impulse Extractor (basic tool)



18G 284

18G 284 B. First Motion Shaft Remover Adaptor

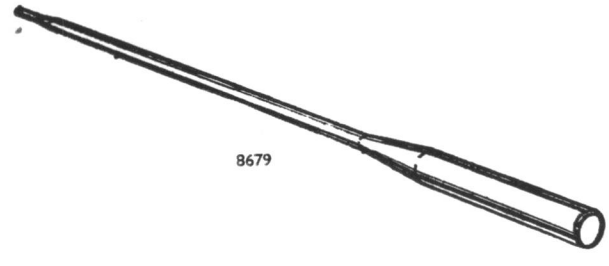
This extractor with the adaptor positioned in the screwed end will withdraw both the first motion shaft and bearing, provided the drive gear has been removed and the bearing circlip extracted.



18G 284 B

18G 471. Dummy Layshaft

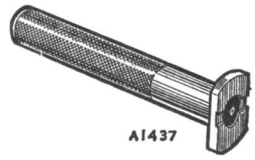
A pilot for lining up the gears and retaining the thrust washers in position prior to inserting the layshaft proper.



18G 471

18G 569. First Motion Shaft Bearing Circlip Gauge

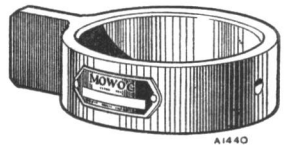
The use of this gauge will help to determine the correct size circlip required to retain the first motion shaft bearing in position, and at the same time ensure that the essential amount of end-float is still maintained. The two gauge sizes are shown on the handle adjacent to the relevant gauge.



18G 569

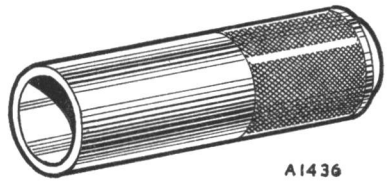
18G 572. Synchromesh Unit Assembly Ring

Designed to facilitate the assembly of mated synchronizer and sleeve by enabling the springs and balls to be inserted quickly and easily.



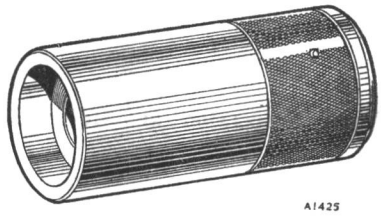
18G 572

18G 573. Change Speed Shaft Oil Seal Replacer



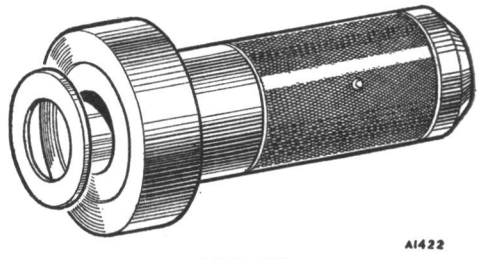
18G 573

18G 578. Differential Bearing Replacer



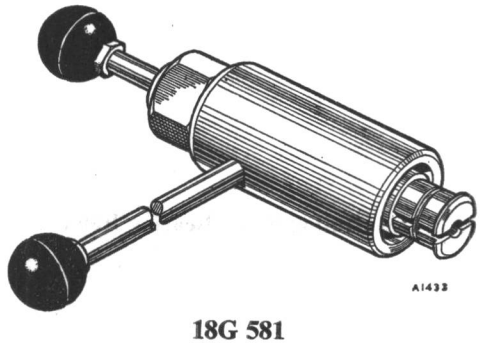
18G 578

18G 579. First and Third Motion Shaft Bearing Replacer



18G 579

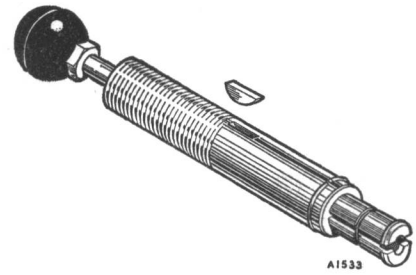
18G 581. Front Suspension and Idler Gear Needle-bearing Remover



18G 581

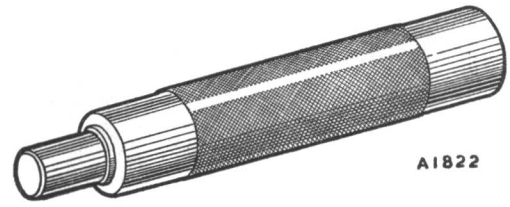
18G 581 B. First Motion Shaft Spigot Bearing Remover Adaptor

Use with the body of 18G 581 to remove the needle-roller assembly from the first motion shaft.



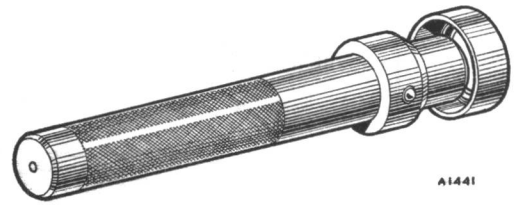
18G 581 B

18G 589. First Motion Shaft Spigot Bearing Replacer



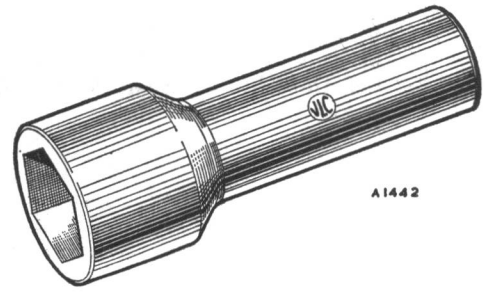
18G 589

18G 582. Front Suspension and Idler Gear Bearing Replacer



18G 582

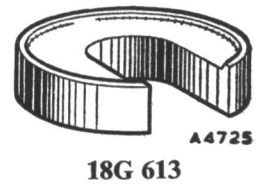
18G 586. Final Drive Gear Nut Spanner



18G 586

18G 613. Third Motion Shaft Bearing Remover

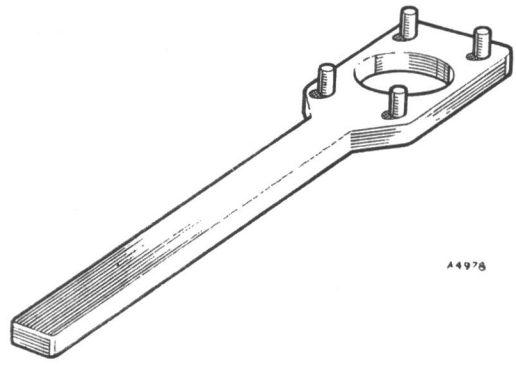
For use when removing the third motion shaft bearing to prevent damage to the housing bore.



18G 613

18G 669. Drive Shaft Coupling Flange Wrench

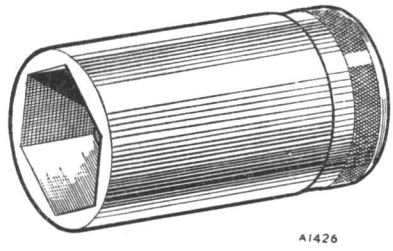
For use when removing or replacing the flange retaining nuts, thus preventing possible damage to the transmission casing when using improvised methods.



18G 669

18G 587. Swivel Hub Ball Pin Nut Spanner

For use on the final drive gear nut in baulk-ring synchromesh transmission.



18G 587

SECTION G

THE DRIVE SHAFTS

	Section
General description	
Drive shafts	G.1

GENERAL DESCRIPTION

Each of the two drive shafts employed has two principal members incorporating a Hardy Spicer constant-velocity joint. The hemispherical interior of the driven shaft and exterior of the driving shaft have six grooves machined in line with the shaft axis, and a ball cage carrying six steel balls is interposed between the two. The steel balls engage the grooves of both members to key them together and at the same time allow the members to hinge freely upon each other.

The rubber boot enclosing this joint must be examined periodically and a new boot fitted immediately there is any sign of damage or deterioration. Ingress of water and road grit through a damaged boot will quickly ruin the joint and require a new drive shaft assembly to be fitted. To fit a new boot the complete drive shaft assembly must be removed from the vehicle.

Section G.1

DRIVE SHAFTS

Removing

To remove the drive shafts, the removal and dismantling procedure as given for swivel hubs in Section K.3 must be followed.

Constant-velocity joint

The constant-velocity (outer) joint of the driving shaft must not be dismantled; should the shaft become unserviceable, a replacement shaft must be fitted.

If a rubber boot enclosing the joint shows signs of damage or deterioration it must be removed and a new boot fitted.

Release the rubber boot from the shaft at the sliding joint and separate the shaft from the joint.

Remove the old boot from the constant-velocity joint, thoroughly clean all traces of rubber from the shaft and carefully wipe the old contaminated grease from the joint itself. It is most important that all the work carried out is undertaken in conditions of extreme cleanliness.

Do not attempt to flush the grease out of the joint. Should the joint have suffered obvious damage through the entry of road dirt, etc., a new shaft drive assembly must be fitted.

Lubricate the splined end of the drive shaft and the small internal diameter of the new rubber boot. Carefully slide the boot over the splines onto the shaft. Repack the constant-velocity joint with 1 oz. (28·35 gm.) of Duckham's Q.5795 Grease, obtainable from BMC Service. Do not use any other lubricant. Pull the rubber boot over the joint, making certain that the moulded rib of the rubber boot is seating in the retaining grooves of the shaft and joint. Secure both the large and small diameters of the boot in position with two turns of 18 S.W.G. (1·22 mm.) soft iron wire, twisting the ends and bending them neatly in the opposite direction to forward rotation (see Fig. G.1). Make certain that the ends of the wire do not damage the rubber boot.

Sliding joint

On later models the lubricating nipple has been deleted from the drive shaft sliding joint and the joint prepacked with special grease and sealed with a rubber boot. Should it be necessary to separate the drive shaft at the sliding joint, it must be repacked with ¾ oz. of Duckham's Q.6383 Grease, obtainable from BMC Service.

To repack a sliding joint, remove the wire securing the rubber boot to the joint flange, ease the boot from the flange, and withdraw the shaft. If the sealing ring fitted to the threaded end of the joint flange is disturbed it must be removed from the flange and the threads resealed with Araldite sealing compound. This sealing ring is not fitted to later models. Fill the cavity of the joint flange to point (A), Fig. G.2, with special grease. Remove the old rubber boot from the drive shaft and clean off any particles of rubber adhering to the shaft. Slide the new rubber seal over the drive shaft and insert the

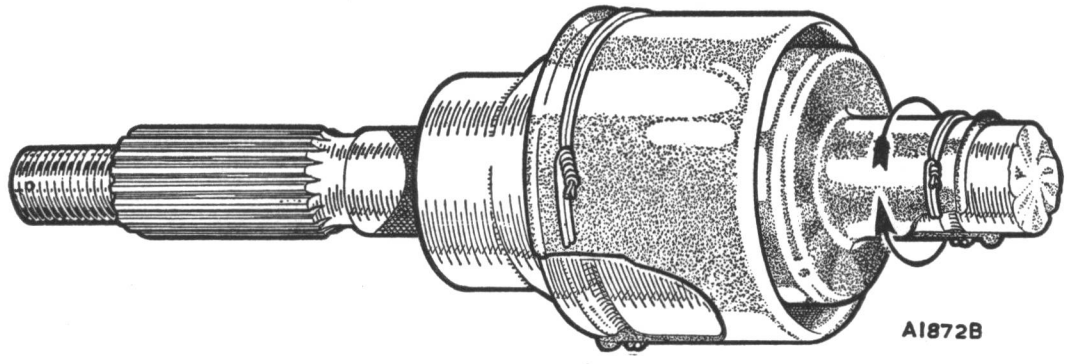


Fig. G.1

The constant-velocity joint cut away to show the method of securing the rubber boot to the shaft and joint. The loose end of the retaining wire must be bent over away from the direction of rotation

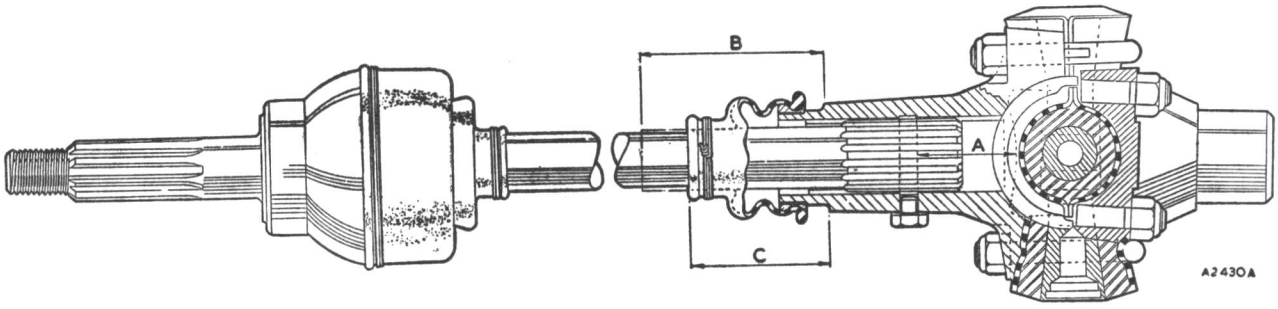


Fig. G.2

A section through the drive shaft sliding joint, showing: (A) *the depth to which the joint flange must be packed with grease;* (B) $2\frac{1}{2}$ *in.* (63·50 *mm.*), *the distance between the shoulders on the flange and shaft, to which dimension the shaft must be adjusted before the boot is secured to the shaft;* (C) $1\frac{7}{8}$ *in.* (47·63 *mm.*), *the correct measurement from the flange shoulder to the outer lip of the boot with the shaft and flange adjusted to dimension* (B)

shaft into the joint flange to the position (B) shown in Fig. G.2. Secure the boot to the joint flange with two turns of 20 S.W.G. soft-iron wire twisted firmly together to ensure a good greasetight seal. Bend the ends of the wire away from the convolutions to ensure that they cannot damage the boot. Hold the drive shaft in a vice and push the flange fully onto the shaft, at the same time holding the outer lip of the boot open with the tang end of a file to allow the displaced air and surplus grease to escape.

Check the diameter of the boot bellows; this should not exceed $1\frac{3}{4}$ in. (4·5 cm.) approximately with the drive shaft pushed fully into the flange; if necessary, squeeze the bellows by hand to reduce the diameter to this figure.

Withdraw the shaft until the seal is positioned as shown at dimension (C), Fig. G.2, and secure the boot to the shaft with two turns of 20 S.W.G. soft-iron wire.

Refitting

Refitting is a reversal of the removal procedure given in Section K.3.

When fitting a replacement drive shaft assembly (of the type fitted with a rubber boot on the sliding joint) to the left-hand side of an early model, it will also be necessary to fit a modified lower arm inner pivot pin to ensure sufficient clearance for the rubber boot. Reference should be made to Fig. G.3 for the dimension of the modified pivot pin.

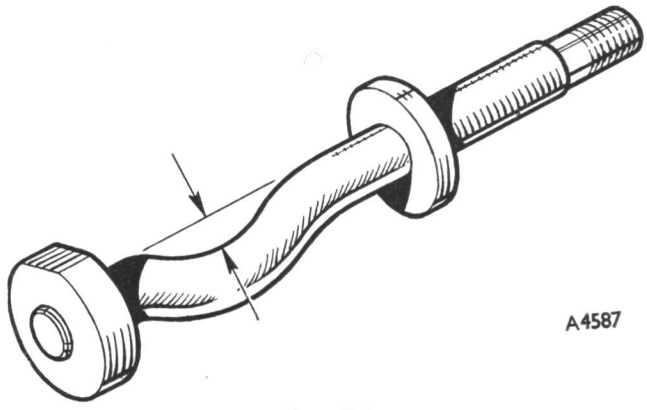


Fig. G.3

The lower arm pivot pin. The measurement at the position indicated must be ·312 *in.* (7·9 *mm.*) *to accommodate the rubber boot of later drive shaft assemblies*

SECTION H

THE REAR SUSPENSION

	Section
Hubs	H.5
Hydrolastic suspension	H.7
Depressurizing, evacuating, pressurizing	H.8
Displacer units	H.9
Radius arms	H.11
Schrader valve extension housing	H.15
Sub-frame	H.12
Suspension pressures and wing heights	H.10
Radius arms	H.2
Radius arms (Moke)	H.14
Spring units	H.3
Struts	H.6
Sub-frame	H.1
Sub-frame (Moke)	H.13
Sub-frame mountings	H.4
Tools	End of Section

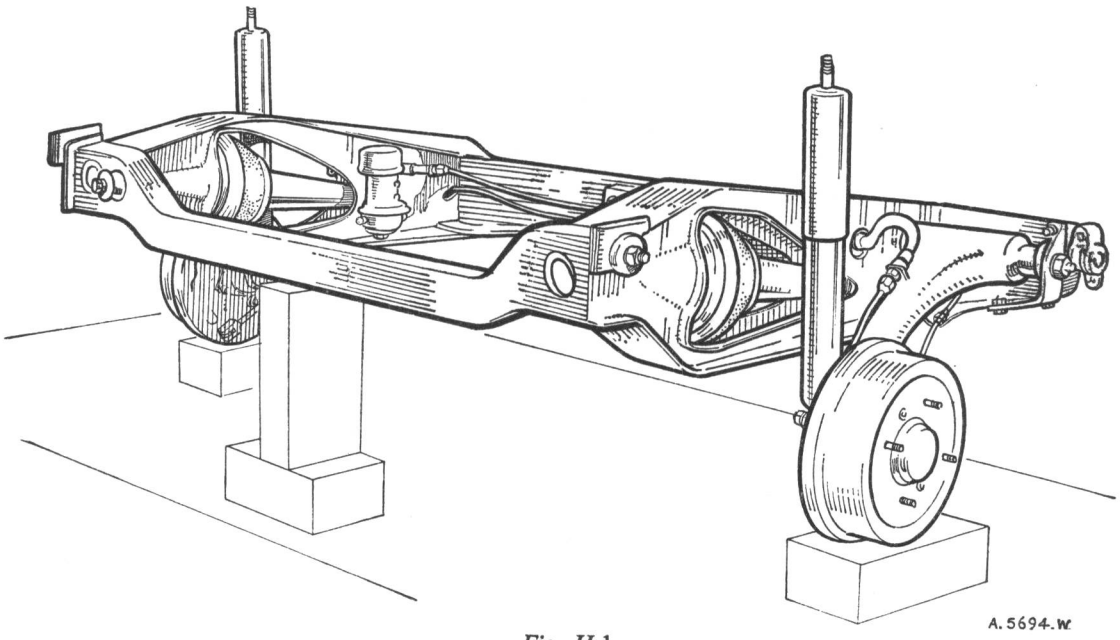


Fig. H.1

The rear sub-frame assembly (rubber suspension)

Section H.1

SUB-FRAME

Removing

Disconnect and remove the earth lead from the battery and both leads from the fuel pump. Release the flexible hoses from both the inlet and delivery connections on the fuel pump, and in doing so drain the fuel tank.

Unscrew the tube nut to release the hydraulic pipe line from the pressure regulating valve mounted on the rear sub-frame front member.

Slacken off and remove the exhaust pipe to manifold clamp, and release the pipe from its fixing point on the gear change extension casing and from the two locations on the rear sub-frame. Take particular note of the number of spacing washers on the gear change casing fixing point. Remove the exhaust pipe assembly from the car.

Remove the end finishers from the sill panels and disconnect the rear dampers from inside the luggage compartment. To gain access to the left-hand damper nut remove the fuel tank as detailed in Section D.1.

Remove the two hand brake cable fairleads from the floor and disconnect the cables from the lever trunnion. Pull the cable through the floor from beneath the car.

Support the body with a sling, locating padded hooks under the rear wings or the luggage compartment top panel.

Withdraw the eight mounting bolts (two at each attachment point) and raise the body to release the complete sub-frame.

Refitting

Refitting is a reversal of the dismantling procedure, with particular attention being given to the following points.

Make certain that the tapped holes in the body are lined up with the holes in the mounting blocks.

The exhaust system must be refitted without the system being subjected to strain; this is most important. The refitting procedure given in Section A.5 must be followed.

Finally, bleed the hydraulic system and readjust the hand brake cables.

Section H.2

RADIUS ARMS

Removing

Release the telescopic damper upper mounting from inside the luggage compartment. To release the left-hand damper drain and remove the fuel tank as detailed in Section D.1.

As an alternative to removing the tank the left-hand damper mounting can be released by undoing the tank strap and gently lifting the tank towards the centre-line of the car, pivoting about the rubber fuel line connector at its forward end without detachment at this point. If this method is adopted it must be undertaken with extreme care, otherwise the rubber connecting hose may be damaged.

Raise the car and support it beneath the rear sub-frame side-member. Remove the road wheel and disconnect the brake hose from the bracket on the trailing arm.

With the radius arm hanging and thereby taking the load off the spring unit, the struts can be prised away from the spring unit flange and pulled out of its seating cup in the trailing arm boss. The nylon cup may be left in the arm when the strut is pulled away; it can, however, be removed with the fingers unless it is damaged and unfit for further service, when it may be necessary to prise it from the arm.

Disconnect the hand brake cable from the actuating lever on the brake backplate, prise the guide tube from

its retaining clip on the arm, lift the arm, and pull the tube away from its anchorage hole on the arm boss. This will enable the cable to be released when the arm is withdrawn. On later models remove the nut from the cable sector pivot and withdraw the sector and cable.

Unscrew the three set screws and remove the end finisher from the sill panel.

Remove the nut and washers from the trailing arm shaft, and the four set screws to release the arm outer support bracket.

Lift the arm assembly away from the car, taking care not to lose the thrust washers and rubber seal fitted between the arm and the side-member.

Dismantling

Remove the dust seal and thrust washers from the ends of the shaft and withdraw the shaft. Should the bronze bushes fitted in the bore of the arm be worn or the shaft show signs of ridging, the bearings should be renewed and a new shaft fitted. Use Service tool 18G 583 to remove the old bushes and tool 18G 584 to fit the new bushes.

Later models are fitted with a cast-type radius arm which has a needle-roller bearing on the inner end of the pivot and a bronze bush on the outer end. The outer bush is renewed in the same way as that of the earlier type. Before reaming the bush the needle bearing and grease tube **must** be removed. Fit the reamer guide bush 18G 588 A in place of the needle bearing and pass the reamer 18G 588 through the guide bush. After reaming, remove the reamer and guide bush and thoroughly clean out all swarf from the interior of the bore of the radius arm. Adequately lubricate all pivot components with grease to Ref. C and reassemble.

Oil is not a satisfactory lubricant at this point and must not be used.

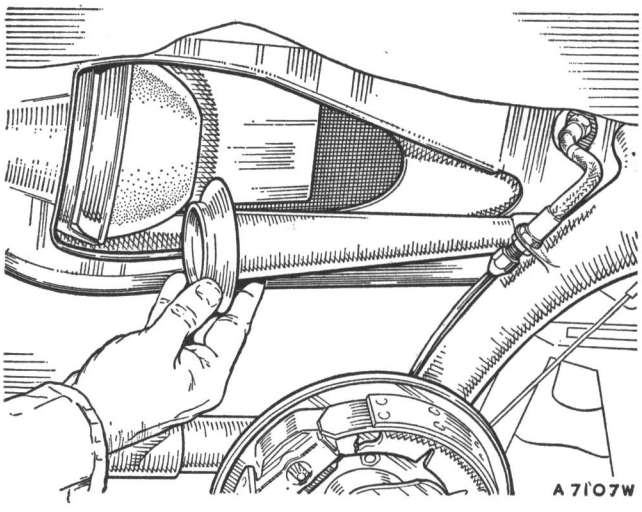


Fig. H.2

Extract the strut from the spring unit and pull it rearwards to disengage the ball end from the radius arm

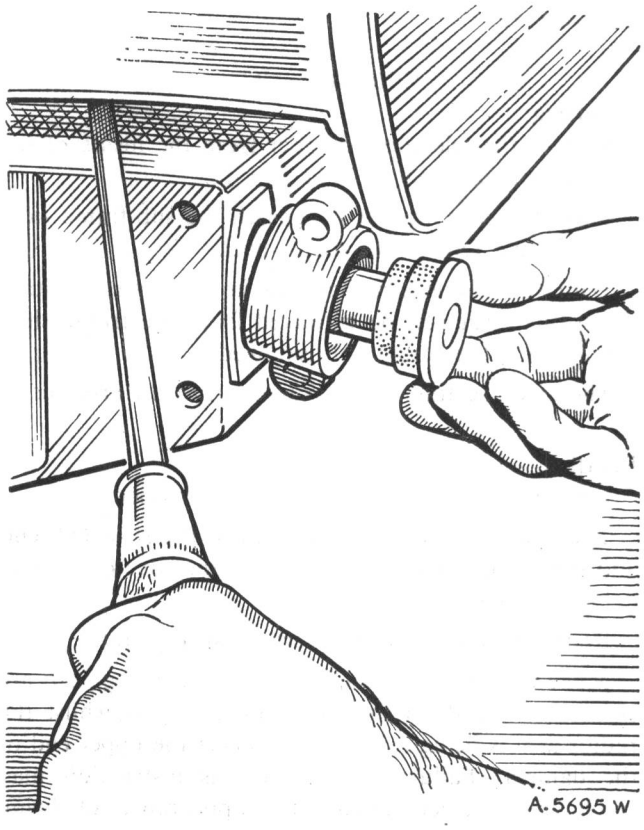


Fig. H.3

Removing the rear sub-frame front mounting support pin assembly

The needle-bearing outer race is removed by the use of Service tool 18G 583 B in conjunction with Service tool 18G 583 and is replaced with Service tool 18G 620.

Refit the needle bearing with its marked end facing outwards.

If the existing shaft is in good order, make certain that the lubricator is clear before refitting to the arm.

The rear hub stub shaft is pressed in.

Refitting

The radius arms may be replaced by carrying out the removal instructions in the reverse order, provided the following points are given special attention.

The nylon cup and dust seal must be repacked with Dextagrease Super G.P., supplied by BMC Service Ltd. in 1-lb. (·45-kg.) tins (Part No. 97H 2276), refitted to the ball end of the spring strut, and the dust seal lipped over the edge of the cup; this is most important. If the nylon seat is fitted into the arm and then followed by the strut ball end, the rubber seal cannot be lipped over the cup to make dust-sealing effective.

Refit the strut and the spring unit (see Section H.3).

Push the cable guide tube (fitted to early models only) into its locating hole on the trailing arm boss and secure it under the clip on the arm before the arm is refitted to the sub-frame.

Finally, bleed the hydraulic system.

Section H.3

SPRING UNITS

Removing

Release the telescopic damper from the inside of the luggage compartment as in Section L.2.

Raise the car, support it beneath the sub-frame side-member, and remove the road wheel.

With the radius arm hanging in its lowest position the spring strut can be extracted from the frame side-member and the spring unit removed.

The nylon seating can be prised out of the arm boss.

Refitting

Refitting is a reversal of the removal sequence.

The nylon seating must be fitted to the strut ball end and the rubber dust seal lipped over the edge of the seal before the strut is refitted.

Refit the strut and then insert the spring unit.

Make certain that the spring unit and spring strut are correctly located on their individual spigots whilst the radius arm is being raised to reconnect the upper end of the damper. Failure to observe this instruction may result in a vehicle having the appearance of being trimmed too high at the back, and would probably damage both the spring and spring strut beyond recovery.

Section H.4

SUB-FRAME MOUNTINGS

Front mounting

Jack up the car at a point between the bumper and the rear body panel.

Remove the radius arm as detailed in Section H.2.

Unscrew and remove the nut securing the mounting support pin to the sub-frame. Withdraw the mounting block to body screws. Prise the body and sub-frame apart sufficiently to enable the support pin, blocks, and rubbers to be extracted.

When refitting, insert the mounting block to body screws before tightening the support pin nut.

Rear mounting

Jack up the car at a point between the bumper and the rear body panel.

Withdraw the mounting block to body screws and remove the nut from the end of the mounting support pin.

Prise the body and the frame apart sufficiently only to allow the block and rubbers to be removed.

When refitting, insert the mounting block to body screws before tightening up the support pin nut.

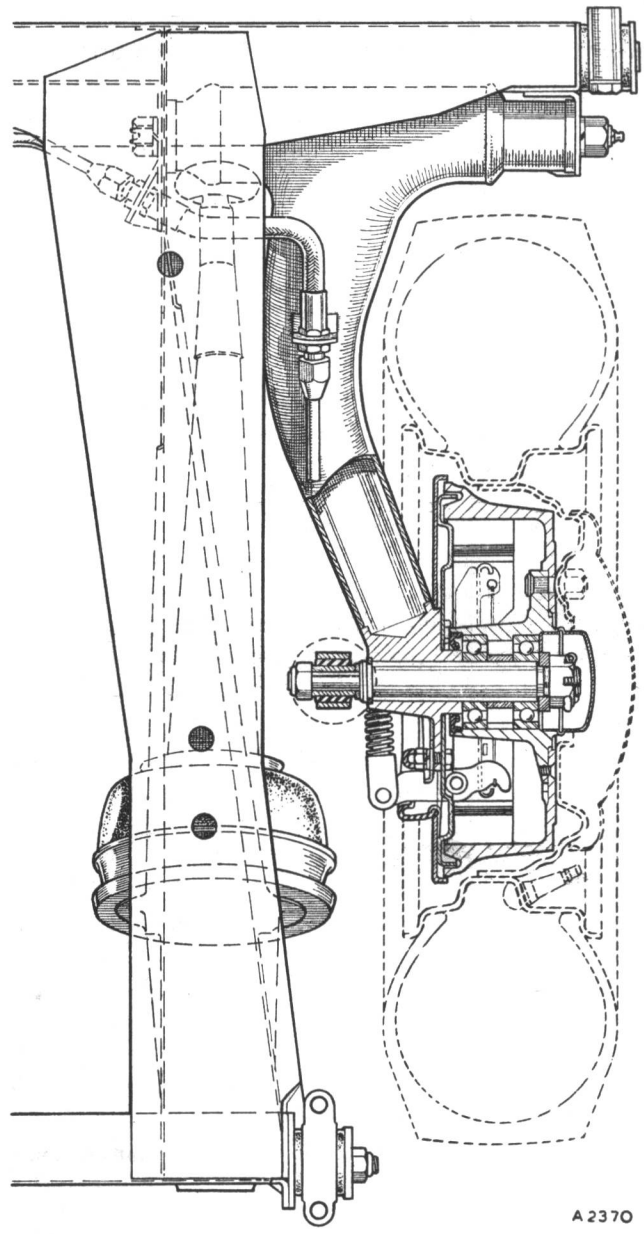


Fig. H.4

The rear radius arm, showing a section through the hub assembly

Section H.5

HUBS

Removing

Jack up the vehicle, and remove the road wheel and the brake-drum.

Prise off the hub cap.

Extract the split cotter pin and remove the slotted nut from the end of the stub shaft.

Withdraw the hub assembly with Service tool 18G 304 and adaptor 18G 304 F.

Dismantling

To remove the hub bearings drift the inner races of both bearings from the hub bore. Remove the grease-retaining seal and extract the outer bearing races, using Service tool 18G 260 with adaptor 18G 260 C.

Reassembling

Make certain that the outer race of both bearings is fitted hard against the register in the hub bore, and that the bearing faces marked 'Thrust' face one another.

Refit the inner races and bearing spacer, at the same time repacking the bearings with grease to Ref. C. Fit a new grease-retaining seal in the hub bore if the old seal was damaged during removal.

Refitting

When refitting the hub and bearing assembly to the stub shaft care must be taken to ensure that the bearing spacer is lifted over the shoulder on the stub shaft before pressure is applied to push the assembly onto the shaft.

Place the thrust washer on the end of the stub shaft with the chamfered bore towards the bearing, refit the slotted nut, tighten up, and secure with the split cotter pin.

Section H.6

SUSPENSION STRUTS

From Car Nos. MA2S4 34099 and AA2S7 44722 the trim height of the vehicle has been raised to give an increased ground clearance by the fitting of circular-section washers between the body of the suspension strut and the shoulder of the knuckle end. When removing a defective strut fitted with one of these washers make certain that a washer is also fitted to the new strut. It is important that only one washer is fitted to each of the four struts.

Later vehicles with cast-type struts do not require washers.

Section H.7

HYDROLASTIC SUSPENSION

The system consists of two front and two rear displacer units intercoupled longitudinally. Each is made of sheet steel and rubber and consists of a piston, a diaphragm, a lower and upper chamber housing, and a conical spring of compressed rubber.

Contact of the front wheels with a road irregularity forces the piston to push the diaphragm up; increased pressure displaces some of the fluid from the bottom chamber to the top chamber. The rubber springs deflect due to the pressure increase and fluid displacement, and the resultant pressure increase causes fluid to discharge through the interconnecting pipe into the rear displacer unit.

The fluid entering the rear displacer forces the diaphragm to react against the piston, resulting in the car height at the rear being raised. These events are virtually simultaneous and the car therefore rides an obstruction without pitch motion of the body. The action of the suspension is similar when the rear wheels negotiate the irregularity.

The fluid used in the system is a mixture of water and alcohol into which an anti-corrosive agent has been introduced.

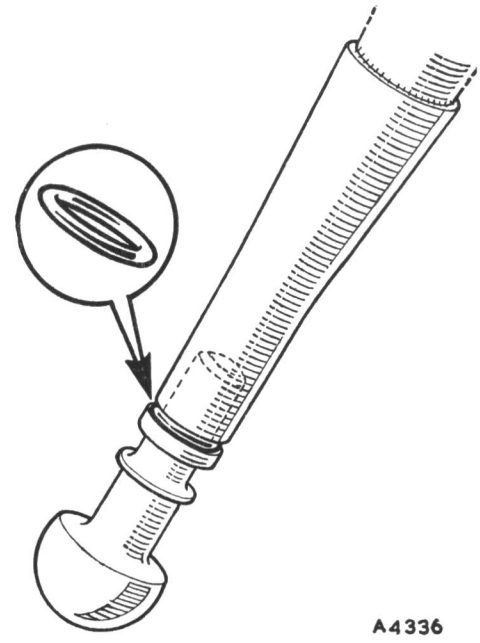


Fig. H.5

A suspension strut, showing the special circular-section washer fitted between the strut body and the knuckle shoulder

The front suspension also comprises upper and lower arms of unequal length located in the side-members of the front sub-frame with their outer ends attached by ball joints to the swivel hubs.

The rear suspension, in addition to the Hydrolastic units, consists of independent trailing arms with auxiliary coil springs.

Section H.8

DEPRESSURIZING, EVACUATING, AND PRESSURIZING THE HYDROLASTIC SYSTEM

Before any major work can be carried out on the suspension and its components the Hydrolastic system must be depressurized and in some cases evacuated. For this operation Service equipment Part No. 18G 703 or 18G 682 must be connected to the pressure valves on the rear sub-frame.

Before using Service equipment 18G 703 check that the pressure/vacuum tank is filled to the level indicated at the rear of the unit. The vacuum and pressure valves are identified by colour only; vacuum (yellow) and pressure (black).

Early service equipment (18G 682) has separate fillers for the pressure and vacuum tanks and are filled to the level shown on the dipstick. One side of the dipstick shows the level in the pressure tank and the other side the level in the vacuum tank.

Top up to the correct levels with Hydrolastic Fluid, BMC Part No. 97H 2801.

The vacuum and pressure valves are identified by number or colour; vacuum (1) yellow, and pressure (2) black.

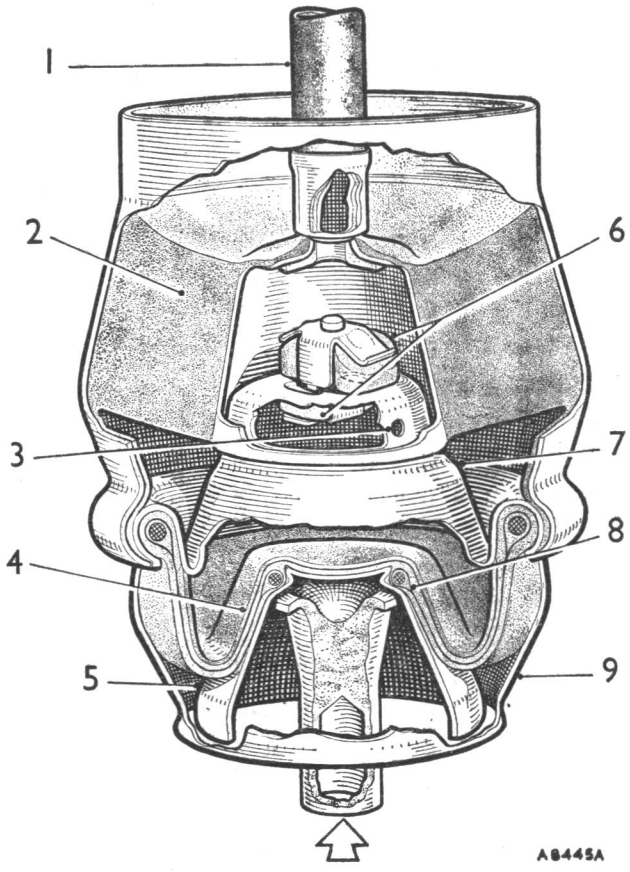


Fig. H.6

The hydrolastic displacer unit

1. Interconnecting pipe.
2. Rubber spring.
3. Damper bleed.
4. Butly liner.
5. Tapered piston.
6. Damper valve.
7. Fluid separating member.
8. Rubber diaphragm.
9. Tapered cylinder.

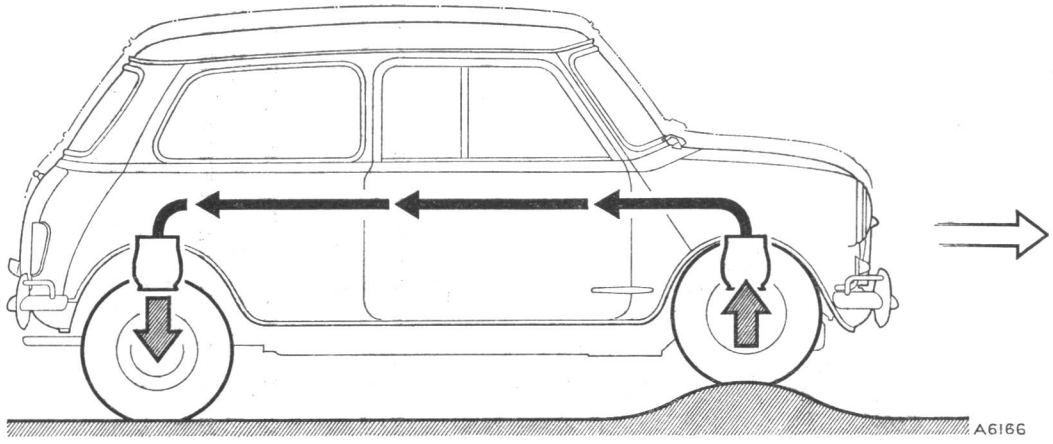


Fig. H.7

The tail rises in response to upward motion of the front wheel

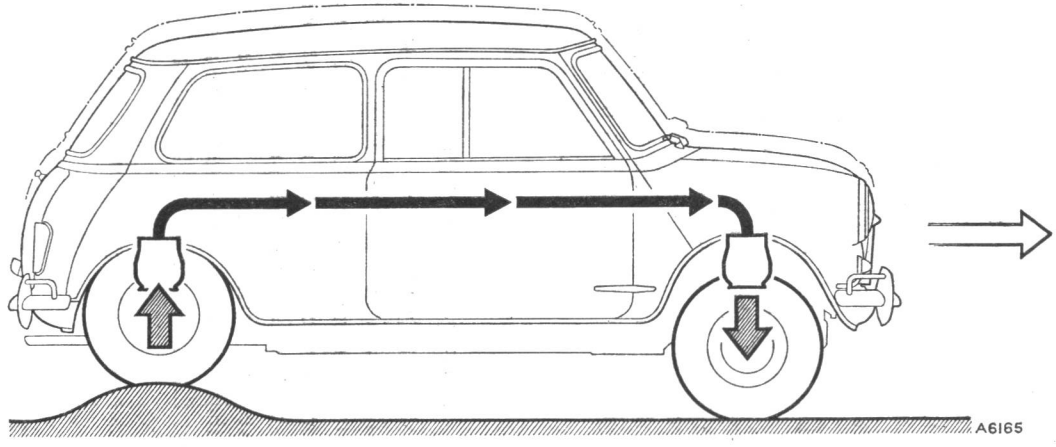


Fig. H.8

The nose rises in response to upward motion of the rear wheel

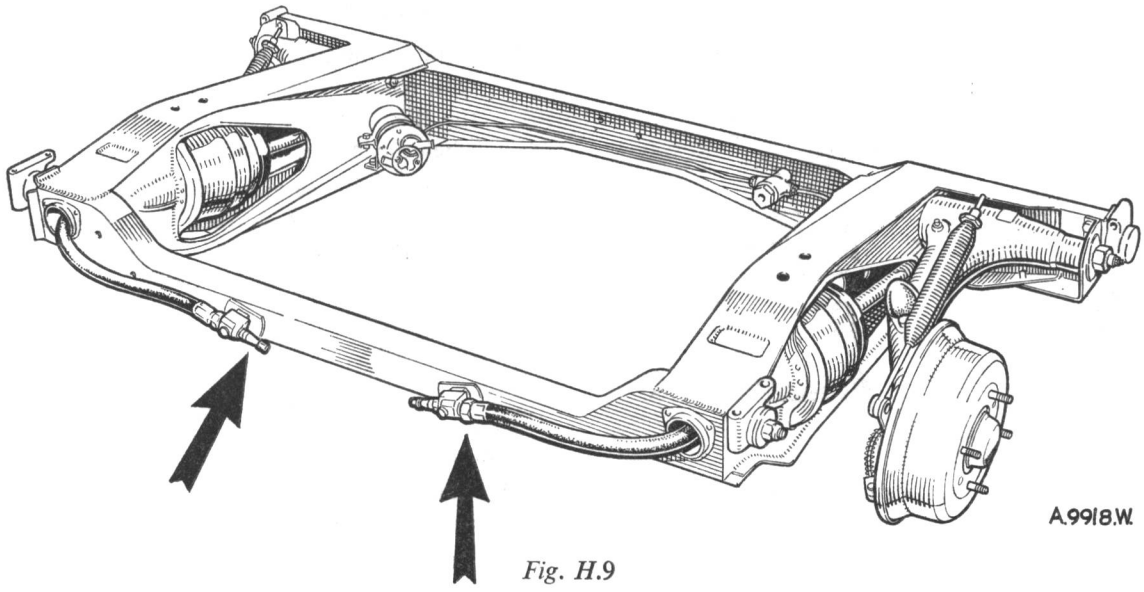


Fig. H.9

The Hydrolastic system pressure valves on the rear sub-frame

Depressurizing

(1) Remove the pressure valve dust cap and connect the black connector to the valve with the knurled knob unscrewed.
(2) Open the black valve (valve 2) and screw in the knurled knob to release the fluid from the suspension system into the unit's pressure tank.
(3) Close the black valve (valve 2). The gauge should read zero if all the pressure has been released.
(4) Remove the black connector and replace the pressure valve dust cap, and the plug in the black connector.
(5) Repeat the above procedure on the second valve to depressurize the other side of the system.

Evacuating

After fitting new interconnecting pipes or displacer units it is essential that the air is evacuated from the system and a partial vacuum created. Service equipment 18G 703 or 18G 682 must be used for this purpose as follows:

(6) Remove the pressure valve dust cap and connect the yellow connector to the valve on the sub-frame.
(7) Close the yellow valve (valve 1) on the service unit.
(8) Operate the vacuum pump until a reading of 27 in. (68·6 cm.) of mercury is obtained on the vacuum gauge and all movement of fluid in the tube has stopped. Subtract ·5 in. (1·27 cm.) of mercury for every 500 ft. (152 m.) above sea-level.
(9) Open the yellow valve (valve 1). Wait one or two minutes until any further movement in the tube has stopped and remove the yellow connector.
(10) Replace the connector plug.

Pressurizing

Having carried out repairs and evacuated to ensure that all air is out of system, the pressurization should be carried out as follows with the car in the condition given in Section H.10 and resting on all four wheels.

(11) Connect the servicing unit black connector to the pressure valve on the rear sub-frame with the knurled knob unscrewed.
(12) Close the black valve (valve 2) and open the bleed valve.
(13) Operate the pressure pump until air is evacuated

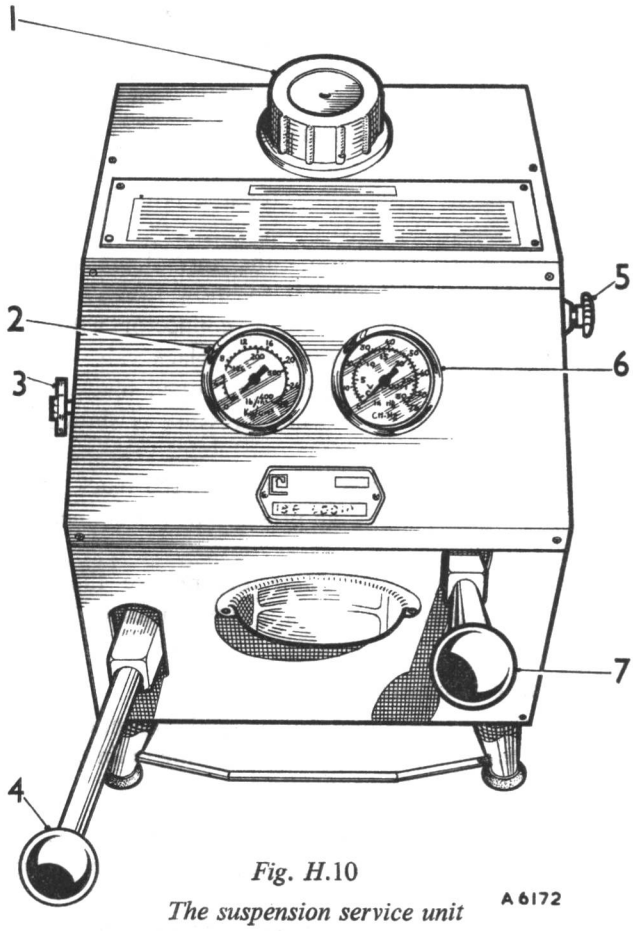


Fig. H.10

The suspension service unit

1. Combined vacuum/pressure tank.
2. Pressure gauge.
3. Black valve.
4. Pressure pump handle.
5. Yellow valve.
6. Vacuum gauge.
7. Vacuum pump handle.

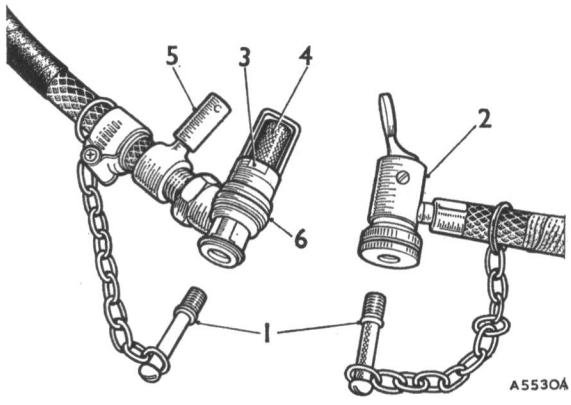


*Fig. H.*11

The suspension service unit connectors

1. Sealing plugs.
2. Evacuating connector.
3. Depressurizing and pressurizing connector.
4. Knurled knob.
5. Bleeding screw.
6. Locking side.

from the connecting tube and fluid appears at the bleed valve.

(14) Close the bleed valve and screw in the knurled knob.

(15) Increase the pressure until the normal operating pressure is obtained (see **'GENERAL DATA'**).

If a new displacer unit has been fitted pressurize to 350 lb./sq. in. (24·6 kg./cm.²).

(16) Unscrew the knurled knob and open the black valve (valve 2) to release the pressure in the connecting pipe.

(17) Remove the black connector and refit the sealing plug.

(18) When pressurizing above the normal pressure as item 15, wait 30 minutes to allow the vehicle to settle. Reconnect the black connector with the knurled knob unscrewed, close black valve (valve 2), screw in the knurled knob, open black valve (valve 2) until the normal pressure is shown on the gauge.

(19) Unscrew the knurled knob, open the black valve (valve 2) to release the pressure in the connecting pipe.

(20) Remove the black connector, replace the connecting sealing plug and the valve dust cap.

Service unit maintenance

Should the service equipment be used continuously, it may be necessary to carry out the following maintenance.

Service tool 18G 682

(21) Remove the front panel.

(22) Remove the drain plug from the vacuum pump, drain the fluid.

(23) Refill with the recommended vacuum oil S.A.E. 10 through the top of the pump. Replace the plug immediately the fluid commences to flow from the drain hole.

(24) Lubricate the service unit mechanism periodically.

Service tool 18G 703

(25) Remove the front panel and fill the vacuum pump with recommended vacuum oil S.A.E. 10 through the filler hole in the top of the pump. Fill only when the level is at the end of its downward stroke.

(26) Lubricate the service unit mechanism periodically.

IMPORTANT.—When the equipment is not in use both valves should be left open.

Section H.9

DISPLACER UNITS

Removal

(1) Raise the car and support it beneath the sub-frame member.

(2) Remove the road wheel and the bump rubber from the sub-frame.

(3) Depressurize the Hydrolastic system (see Section H.8).

(4) Release the helper spring from the radius arm.

(5) Disconnect the flexible Hydrolastic hose from its union on the rear face of the sub-frame.

(6) Remove the displacer strut and turn the unit anti-clockwise and withdraw it from the frame.

Refitting

(7) Reverse the removal instructions.

(8) Rotate the displacer clockwise to lock it into the registers on the locating plate.

(9) Lubricate the strut ball and the nylon seat with Dextragrease G.P. and make sure the dust seal is fitted over the lip of the nylon cup.

(10) Evacuate and pressurize the system (Section H.8).

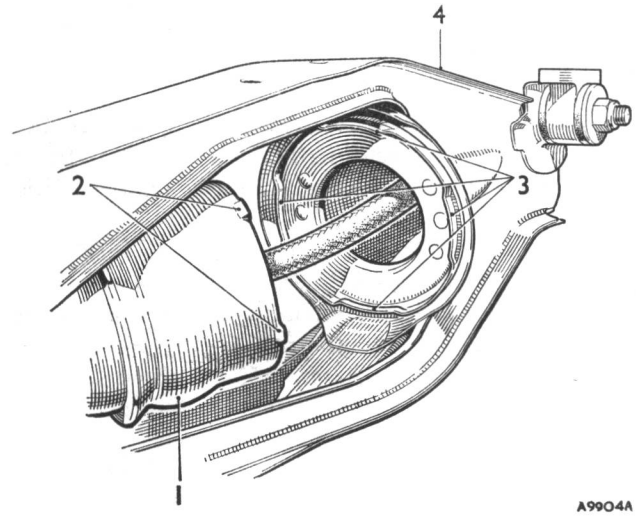


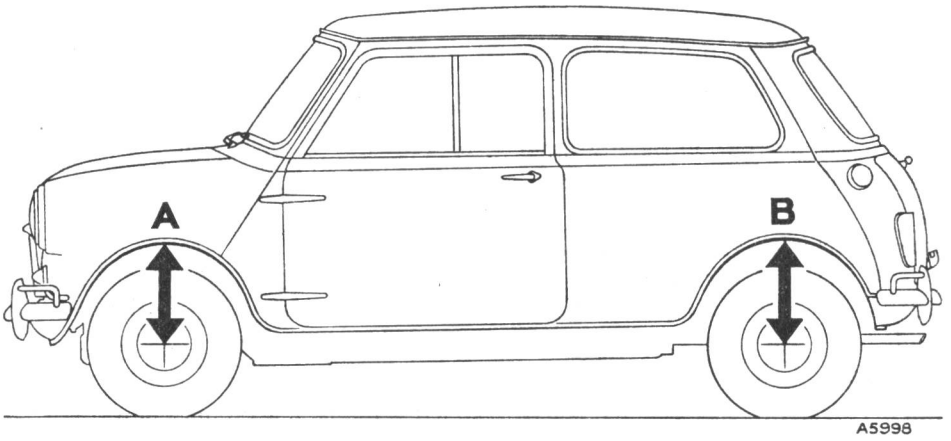
*Fig. H.*12

A rear displacer unit separated from the locating plate

1. Displacer unit.
2. Locating lugs.
3. Locating plate.
4. Sub-frame.

Section H.10

SUSPENSION PRESSURE AND WING HEIGHTS



CONDITION OF CAR

Water; oil; petrol (max.) 4 Imp. gal. (4·8 U.S. gal., 18·2 litres)

Pressure lb./sq. in. (kg./cm.²)	*Front wing height (A) in. (mm.)*	*Rear wing height (B) in. (mm.)*
See **'General Data'**	$13\pm\frac{1}{4}$ ($330\pm6{\cdot}35$)	$13\frac{1}{2}\pm\frac{1}{4}$ ($343\pm6{\cdot}35$)

NOTE.—It is most important that the suspension system should be fitted to the correct pressure (see 'GENERAL DATA').

At initial assembly, or subsequently if a new Hydrolastic unit is fitted, the system is to be pressurized to 350 lb./sq. in. (24·6 kg./cm.²) for a period of 30 minutes, before setting to the operating pressure given in the **'GENERAL DATA'.**

To check and adjust the pressures

With the car in the above condition and resting on all four wheels carry out the following.

Fit the **black** connector with the knurled knob unscrewd. Close valve 2 (black valve) and open the bleed valve. Use the pressure pump until air is evacuated from the connection tube and fluid appears. Close the bleed valve, operate the pressure pump until the working pressure is reached (see **'GENERAL DATA'**), and then screw in the knurled knob. If the pressure reading is low, operate the pressure pump until the correct working pressure is reached (see **'GENERAL DATA'**). If the pressure gauge reading is high, adjust to the correct working pressure by opening valve 2 (black valve). When the pressure reading is correct unscrew the knurled knob, open valve 2 (black valve), and remove the **black** connector. Replace the sealing plug in the **black** connector and the pressure dust cap on the suspension unit interconnecting pipe valve.

A check can also be made on the suspension pressure, using Service tool 18G 685 or 18G 703. The tool must first be adjusted in the following manner. Connect the pump to a pressure gauge fitted with a Schrader valve from which the core has been removed. Fill the tool with Hydrolastic fluid and operate the hand lever of the tool, noting the pressure registered on the gauge. Adjust the valve seat until the working pressure of the system is registered on the gauge (see **'GENERAL DATA'**). Tighten the lock screw and replace the washer and screw.

Fit the connector to the suspension unit interconnecting valve and operate the hand lever until the relief valve in the tool commences to operate. The suspension will now be at its correct working pressure.

NOTE.—Should the Hydrolastic suspension system suffer damage and the fluid be lost, the suspension arms on the damaged side of the vehicle will contact the bump rubbers at both front and rear. In this condition the car may be driven with complete safety at 30 m.p.h. (50 km.p.h.) over metalled roads.

Section H.11

RADIUS ARMS

(Hydrolastic Suspension)

Removal

(1) Depressurize the Hydrolastic system (see Section H.8).

(2) Remove the road wheel and release the helper spring from the radius arm.

(3) Raise the vehicle and support it beneath the sub-frame side-member.
(4) Disconnect the brake hose from the radius arm.
(5) Disconnect the hand brake cable and release the cable sector from the arm.
(6) Remove the bump rubber from the sub-frame and the end finisher from the sill panel.
(7) Remove the displacer strut.
(8) Remove the nut and washers from the arm pivot shaft and the four set screws to release the outer bracket.
(9) Lift the radius arm assembly away from the vehicle, taking care not to lose the thrust washers and rubber seal fitted between the arm and the sub-frame side-member.

Dismantling is described in Section H.2.

Refitting

(10) Reverse the removal instructions.
(11) Lubricate the strut ball end and the nylon seat with Dextragrease Super G.P. and make sure the dust seal is fitted over the lip of the nylon cup.
(12) Bleed the hydraulic brake system.
(13) Pressurize the Hydrolastic system (see Section H.8).

Section H.12

SUB-FRAME

(Hydrolastic Suspension)

Remove and refit the sub-frame as in Section H.1, with the following additional operations:

(1) Depressurize and evacuate the Hydrolastic system prior to any dismantling, following the instructions in Section H.8.
(2) Disconnect both helper springs from the radius arms.
(3) Disconnect the pressure valves from the sub-frame.
(4) Evacuate and re-pressurize the Hydrolastic system when reassembly is complete, following the instructions in Section H.8.

Section H.13

SUB-FRAME

(Moke)

Remove and refit the sub-frame as in Section H.1 with the following exceptions:

Fuel tank and pump removal not necessary.

Section H.14

RADIUS ARMS

(Moke)

Remove and refit as in Section H.2 with the following exceptions:

Fuel tank and pump removal not necessary.

Section H.15

SCHRADER VALVE EXTENSION HOUSING

(Hydrolastic Suspension)

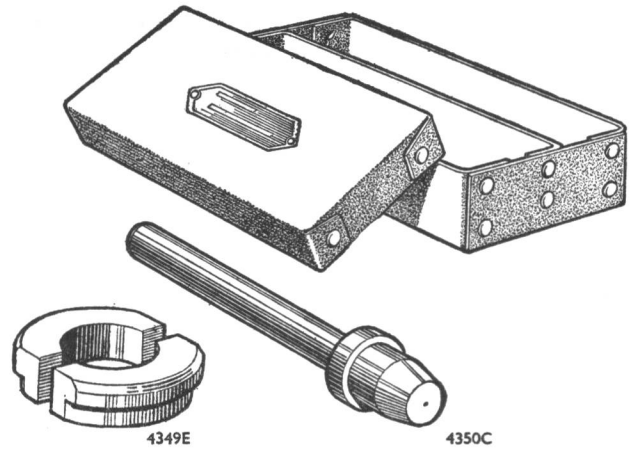
To rectify fluid leakage from the Schrader valve extension housing to the pipe elbow:

(1) Depressurize the Hydrolastic system, see Section H.8.
(2) Remove the Schrader valve extension housing from the pipe elbow and clean the threads of both the valve extension housing and the elbow.
(3) The threads of the valve extension housing must be lightly coated with Loctite Grade A after the housing has been re-started on its threads in the elbow. Under no circumstances must Loctite be applied to the valve extension housing before inserting it in the elbow.
(4) Tighten the valve extension housing to a torque of 16 to 20 lb. ft. (2·2 to 2·8 kg. m.) and leave for 24 hours at room temperature before pressurizing the system.
(5) Evacuate and pressurize the system, see Section H.8.

SERVICE TOOLS

18G 260. Hub Bearing Outer Race Remover (basic tool)

18G 260 C. Hub Bearing Outer Race Remover Adaptor

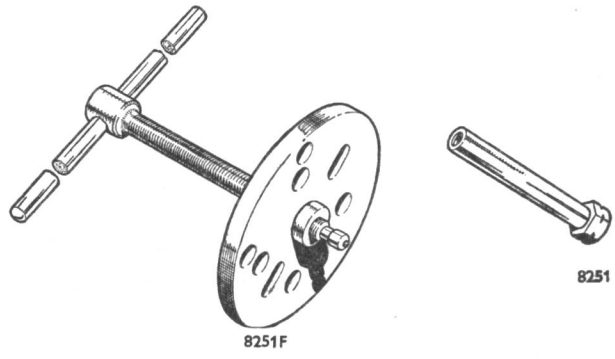


18G 260 C 18G 260

18G 304. Front and Rear Hub Remover (basic tool)

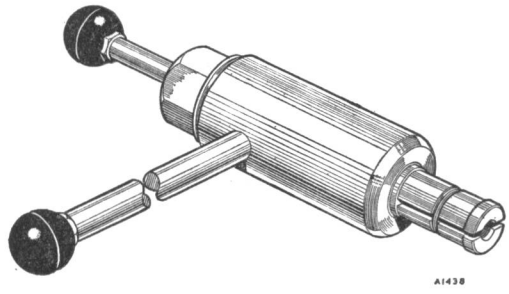
18G 304 F. Front and Rear Hub Remover Bolt Adaptor

Two of the adaptor bolts 18G 304 F. are required in order to pull the rear hub from the rear radius arm.



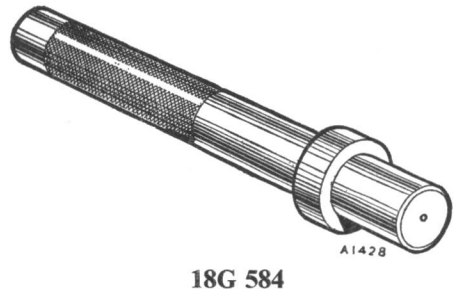
18G 304 18G 304 F

18G 583. Rear Radius Arm Bush Remover



18G 583

18G 584. Rear Radius Arm Bush Replacer



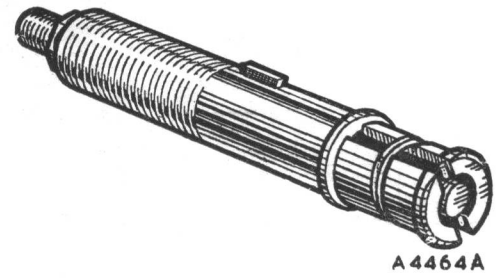
18G 584

18G 588. Rear Radius Arm Bush Reamer

18G 588

18G 583 B. Rear Radius Arm Needle Bearing Remover Adaptor

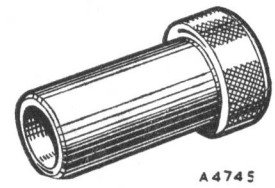
For use in conjunction with Service tool 18G 583 when removing the needle bearing outer race on cast-type radius arms only.



18G 583 B

18G 588 A. Reamer Guide Bush

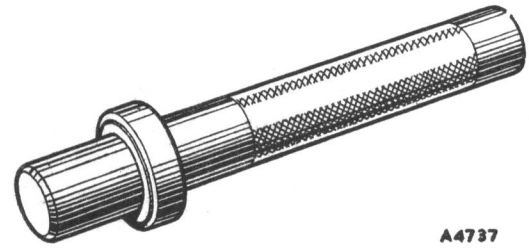
Use with 18G 588 when reaming the outer bush on the cast-type rear radius arms.



18G 588 A

18G 620. Rear Radius Arm Needle Bearing Replacer

This tool is essential to ensure correct fitting of the needle bearing in the cast-type rear radius arm.



18G 260

SECTION J

THE STEERING GEAR

	Section
General description	
Front wheel alignment	J.4
Steering	
Column	J.2
Lubrication	J.5
Nylon tie-rod ball ends	J.6
Rack and pinion	J.3
Wheel	J.1
Tools	End of Section

GENERAL DESCRIPTION

The rack and pinion type steering gear is secured to the engine bulkhead. Tie-rods, operating the steering arms, are attached to each end of the steering rack by ball joints enclosed in rubber gaiters.

The steering-column engages the splined end of a helical-toothed pinion to which it is secured by a clamp bolt.

Pinion end-play is eliminated by adjustment of the shims fitted beneath the pinion tail bearing retaining plate. A damper pad inserted beneath the steering rack controls the backlash between the pinion and rack.

WARNING.—When the vehicle is hoisted so that the front wheels are clear of the ground, forceful movement of the wheels from lock to lock must be avoided, otherwise damage may occur within the steering mechanism.

Section J.1

STEERING-WHEEL

Remove the screw in the wheel hub to release the horn-push control. Unscrew and remove the steering-wheel retaining nut and withdraw the steering-wheel.

When refitting the steering-wheel apply a torque of 41 lb. ft. (5·76 kg. m.) to tighten the steering-wheel nut.

Section J.2

STEERING-COLUMN

Removing

Disconnect the direction indicator and horn control wire snap connectors located below the parcel shelf.

Remove the nut, bolt, and spring washer clamping the column to the steering pinion shaft.

Remove the nut and bolt from the column support clip, pull the column assembly upwards to disengage it from the pinion shaft splines, and lift it from the car.

Refitting

The method of refitting the steering assembly is a reversal of the removal instructions.

Make sure that the road wheels are in the straight-ahead position.

Push down the column assembly, engage the marked spline of the pinion shaft with the slot in the inner column clamp, ensuring that the clamp bolt can be easily inserted. Tighten the clamp bolt to a torque of 8 to 9 lb. (1 to 1·2 kg. m.). The clamp must be below and horizontal to the column in order that the direction indicator cancelling lug is positioned upwards at an angle of 16°.

Section J.3

STEERING RACK AND PINION

Removing

Remove the air cleaner from the carburetter.

Slacken the steering-column to parcel shelf clamp bolt.

Remove the nut, bolt, and spring washer securing the steering-column to the pinion shaft and pull the column from the shaft.

Jack up the car beneath the front sub-frame and remove both the front road wheels and the hydraulic dampers.

Remove the four screws and nuts securing the rear of the front sub-frame to the floor of the body.

Knock back the locking plate tabs and remove the four bolts securing the sub-frame towers to the engine bulkhead cross-member. In cases where studs are fitted at this location the studs must be withdrawn to avoid damage to the threads or distortion of the studs.

Remove the exhaust pipe to manifold clamp and disconnect the pipe from its fixing on the gear change extension.

Release the engine tie-rod from the cylinder block.

Slacken the front sub-frame mounting bolts.

Slacken and remove the four nuts retaining the two rack 'U' bolts to the floor.

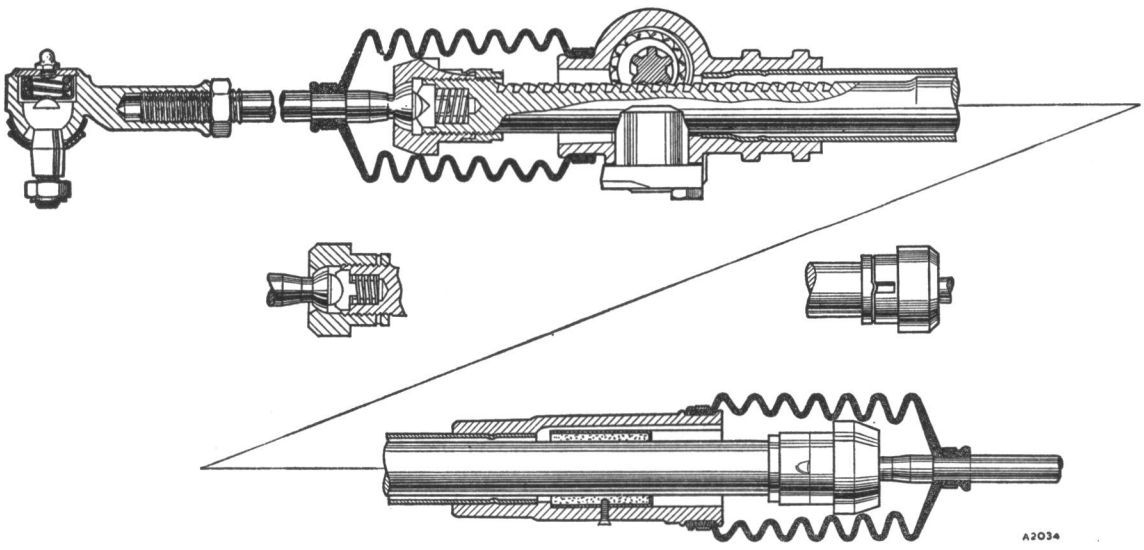


Fig. J.1

A section through the steering rack and tie-rod, with the early-type ball housing and locking ring shown inset

Support the body and lower the jack: the sub-frame will then drop down from the body, giving clearance to remove the 'U' bolts.

Should it be necessary to prise the sub-frame down farther, use a lever between the top of the towers and the wing valance.

Withdraw the steering rack assembly from the driver's side of the vehicle.

Dismantling

Unlock the ball end retaining nuts on the steering tie-rods and remove the ball end assemblies.

Release the gaiter clips from the rack housing and tie-rods, drain the lubricating oil, and remove the rubber gaiters.

Remove the two damper housing retaining bolts and withdraw the housing, together with the damper and damper spring. Care must be taken not to lose any of the housing shims.

Unscrew the two bolts securing the pinion shaft tail bearing retaining plate, and remove the plate and packing shims. Extract the lower thrust washer, bearing, and bearing race, and withdraw the pinion. The top bearing race, bearing, and thrust washer will be trapped behind the rack teeth and can be removed after the pinion is withdrawn.

Extract the pinion shaft oil seal.

Use the steering rack ball joint spanners, Service tool 18G 707, to unlock and remove the ball housing.

Punch the indentations in the lock washer clear of the slots in the locking ring and the ball housing. On later models where a locking washer is not fitted punch or prise up the indentations in the locking ring clear of the slots in the rack and ball housing. Slacken back the locking ring and unscrew the housing to release the tie-rod, ball seat, and seat tension spring.

Withdraw the rack from the pinion end of the rack housing; this will obviate damage to the felt bush fitted in the opposite end of the housing by the rack teeth.

To remove the felt bush unscrew the self-tapping screw securing the bush housing through the rack housing about two turns. Prise up the felt at the joint and extract it with a pair of thin, long-nosed pliers.

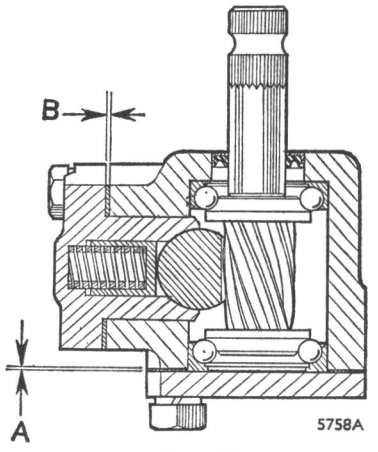


Fig. J.2

A section through the steering pinion and rack damper. Feeler gauge measurements at both (A) *and* (B) *must be taken without the packing shims fitted*

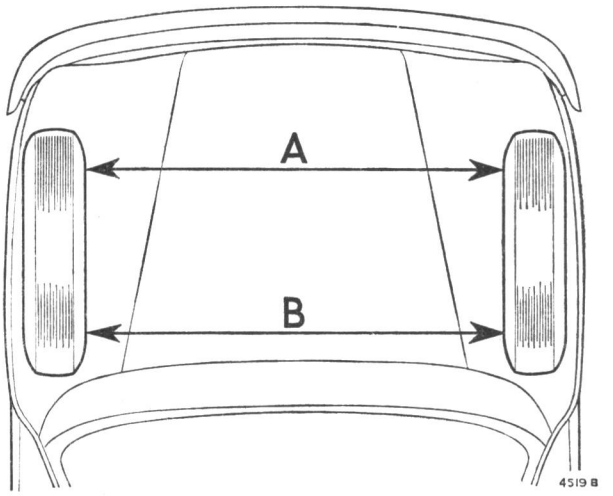


Fig. J.3

The front wheel alignment check must be taken with the front wheels in the straight-ahead position. Dimension (A) *must be* $\frac{1}{16}$ *in.* (1·59 *mm.*) *greater than* (B)

Examining for wear

Thoroughly clean and examine all parts of the assembly; components showing signs of wear must be replaced with new parts. Fractures, hollows, or roughness in the surfaces of the rack or pinion teeth will render them unserviceable.

Take particular note of the rubber gaiters; should they be damaged or show the slightest signs of deterioration, they must be replaced with new ones. The tie-rod ball housing and ball seat should also be subjected to a careful check and new parts fitted if excessive wear is evident.

The outer ball socket assembly cannot be dismantled, and must therefore be renewed complete if it is worn or damaged.

Examine the felt bush fitted in the end of the rack housing and fit a new one if it shows signs of damage or deterioration.

Reassembling

Fit a new felt bush to the end of the rack housing; soak the new felt in extreme-pressure S.A.E. 140 oil. Grip and roll the felt with a pair of long-nosed pliers, carefully insert it into the housing, withdraw the pliers, and even out the felt, pressing it to the contour of the housing. It is most important that the felt bush housing is secured with the self-tapping screw through the rack housing. Before tightening up the screw apply a sealing compound under the screw head.

Refit the top pinion bearing. Insert the rack into the housing and refit the pinion and lower pinion bearing. Replace the pinion tail bearing cover without the packing shims and use a feeler gauge to measure the clearance between the cover and the housing ([A], Fig. J.2). Do not overtighten the cover screws or an incorrect measurement may be obtained.

Remove the cover and refit with packing shims to the value of the feeler gauge measurement minus ·002 in. (·05 mm.) to obtain the recommended preload. The joint faces must be treated with shellac to prevent lubricate seepage.

Screw the ball housing lock ring onto the rack end to the limits of the thread and refit the locking washer. On later models where a locking washer is not fitted a new locking ring must be used. Refit the seat spring, seat, tie-rod, and ball housing, tightening up firmly until the tie-rod is pinched. Advance the locking ring to meet the ball housing and check that the tie-rod is still pinched. Slacken back the ball housing one-eighth of a turn to allow full articulation of the tie-rod. Relock the housing by tightening up the locking ring to a torque of 33 to 37 lb. ft. (4·60 to 5·63 kg. m.). at the same time ensuring that the ball housing does not rotate.

If adjustment is correct the preload on the tie-rod ball spheres must be such that a torque of 32 to 52 lb. in. (·368 to ·599 kg. m.) is required on the tie-rod to produce articulation.

A 4 to 6·5 lb. (1·81 to 2·8 kg.) pull with a spring balance attached to the steering ball end will give this figure. Lock up by punching the washer into the slots of the housing and the locknut. On later models where a locking washer is not fitted the housing is secured in the locked position by punching the lips of the locking ring into the slots in the ball housing and rack.

Damper adjustment (*early models*)

To adjust the rack damper the plunger must be replaced in the damper housing and refitted without the plunger spring or the packing shims. Tighten up the two securing bolts with the rack in the straight-ahead position until it is just possible to rotate the pinion shaft with the bearing preload gauge 18G 207 and adaptor 18G 207 A set to 15 lb. in. (·173 kg. m.). Take a feeler gauge measurement between the damper housing flange and its seating on the rack housing ([B], Fig. J.2). Remove the damper housing, insert the spring and the plunger, and refit the assembly with packing shims to the value of the feeler gauge measurement plus ·002 in. (·051 mm.). The joint faces must be treated with shellac to prevent lubricant seepage.

Damper adjustment (*later models*)

To adjust the rack damper the yoke must be refitted with the springs but without the packing shims.

Tighten the securing bolts with the rack in the straight-ahead position until it is just possible to rotate the pinion shaft with the bearing preload gauge set to 15 lb. in. (·173 kg. m.).

Take a feeler gauge measurement between the damper cover-plate and its seating on the rack housing. Remove the damper cover, treat the joint faces with shellac, and refit the cover with the packing shims to the value of the feeler gauge measurement minus ·001 to ·003 in. (·025 to ·076 mm.), (Fig. J.4 [B]).

The torque load required to start movement of the pinion after assembly must not exceed 25 lb. in. (·29 kg. m.).

Fit a new pinion shaft seal.

Refit the rubber gaiters to the housing and the tie-rods. Before securing the gaiter clip on the tie-rod at the pinion end stand the assembly upright and pour in approximately ⅓ pint (·4 U.S. pint, ·2 litre) of Extreme Pressure S.A.E. 140 oil through the end of the gaiter.

Refit and tighten the gaiter clip.

Refit the ball ends and locking nuts.

Centralize the rack and mark the pinion so that the position of the rack can be checked after the assembly has been fitted to the car.

On later models a line is stamped on the end of the pinion shaft; assemble with the stamped line vertical and below the horizontal centre-line of the column for a right-hand-drive vehicle and above the horizontal centre line for a left-hand-drive vehicle. The full travel of the rack from stop to stop is 3·5 in. (89 mm.), 1·75 in. (44·5 mm.) in each direction. Two-and-one-third turns of the pinion will give complete travel of the steering rack from stop to stop.

Reassembling and refitting

Reassembling is a reversal of the dismantling procedure

Refit the rack to the car, insert the 'U' bolts, but do not fully tighten the nuts.

Centralize the pinion shaft in the hole in the toeboard.

Slacken the screws retaining the steering-column bracket to the parcel shelf so that the bracket can slide transversely, and remove the nut and bolt securing the column clip to the bracket.

Check that the rack is still in the centre of its travel. Push down the column assembly, engage the marked spline of the pinion shaft with the split portion of the inner column clamp, ensuring that the clamp bolt can be easily inserted. Tighten the clamp bolt to a torque of 8 to 9 lb. ft. (1·2 kg. m.).

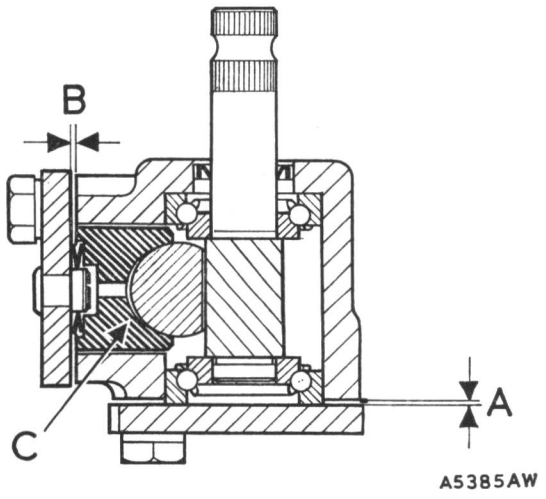


Fig. J.4

A section through the steering pinion and rack damper

A. Take a feeler gauge measurement and fit the pinion end cover with shims to the value of the measurement minus ·001 to ·003 in. (·025 to ·076 mm.) before fitting the damper yoke (C).
B. Measure the gap and fit shims.
C. Damper yoke.

Refit the bolt securing the column clip to the parcel shelf bracket and tighten fully. Tighten the retaining screws and the rack 'U' bolts.

The exhaust system and engine tie-rod must be reconnected by following the procedure detailed in Section A.5.

Check the wheel alignment as in Section J.4.

Section J.4

FRONT WHEEL ALIGNMENT

When checking or setting the front wheel alignment it is essential to use equipment designed to work at the specified height and diameter given below and preferably a gauge which measures the angle involved rather than the difference in distance between the wheels in front of and behind the centres.

With the car unladen, tyres at the recommended pressure, and the steering in the straight-ahead position, each wheel should make an angle of 7′ 30″ with the longitudinal axis of the car. When this angle is correct the distance between the front of the wheels will be $\frac{1}{16}$ in. (1·59 mm.) greater than that at the rear (see Fig. J.3). Owing to the fact that the wheels are not parallel to each other, it is obvious that the distances between the wheels will vary according to the point on the tyre diameter at which they are taken; this location is specified as follows and must be strictly observed. **Measurements must be taken on a 14½ in. (368·3 mm.) diameter (on the side wall of the tyre) at a distance of 9·4 in. (239 mm.) above the ground surface.**

Turn the wheels to the straight-ahead position. With conventional base-bar-type alignment gauges measurements in front of and behind the wheel centres should be taken at the same points on the tyres. This is achieved by marking the tyres where the first reading is taken and moving the car forward approximately half a road wheel revolution before taking the second reading at the same points.

With an optical gauge two or three readings should be taken with the car **moved forward** to different positions—180° road wheel turn for two readings and 120° for three readings. The average figure should then be calculated.

Wheels and tyres vary laterally within their manufacturing tolerances or as the result of service, and alignment figures obtained without moving the car are unreliable.

If the wheel alignment is incorrect adjust the track by slackening the locknut for each tie-rod ball joint and the clips securing the rubber gaiters to the tie-rods, then rotate each tie-rod equally in the necessary direction. Ensure that the tie-rod is free to rotate inside the rubber gaiter. Should the gaiter be twisted, it will be damaged and cause oil leaks. Both tie-rods have right hand threads.

NOTE.—To ensure that the steering rack is in the central position and that the steering geometry is correct it is important that the tie-rods are adjusted to exactly equal lengths.

After adjustment tighten the ball joint locknuts.

When locking up the tie-rod ball joints, hold the ball joint with a suitable tool when tightening the locknut. Do not allow a load to be imposed on the ball socket, otherwise serious damage can result to the nylon seating.

Section J.5

STEERING RACK LUBRICATION

No provision is made for periodical lubrication of the steering rack; replenishment is necessary only where there is evidence of oil loss from the rack housing or the rubber gaiters. Since lubricating nipples are not provided, the following procedure should be followed in order to make good any oil loss, provided the leakage can be rectified without the rack assembly being removed from the vehicle.

Remove the retaining clip and release the rubber gaiter from the right-hand end of the rack housing (left-hand end on left-hand-drive vehicles) and move the rack to the straight-ahead position. Insert an oil nozzle into the end of the rack housing and inject not more than ⅓ pint (·44 U.S. pint, ·2 litre). Use extreme-pressure S.A.E. 140 oil. Reconnect the rubber gaiter and move the rack from side to side to distribute the oil throughout the housing.

WARNING.—If the vehicle is hoisted with its front wheels clear of the ground care should be taken to avoid forceful movement of the wheels from lock to lock, otherwise damage may occur within the steering mechanism.

Section J.6

NYLON TIE-ROD BALL ENDS

Later ball joints have nylon seats sealed for life and protected by rubber boots; no lubrication is required.

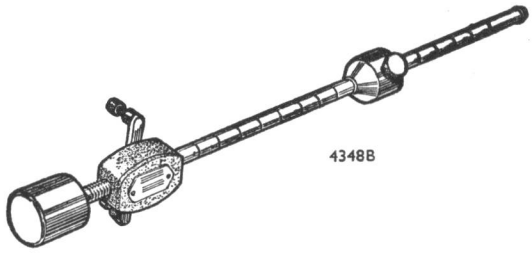
The rubber boots must be maintained in good condition, and if it is found that a boot has become damaged in service both boot and joint must be renewed. However, if a boot is damaged in the workshop during the removal of a joint which has therefore not become contaminated by road dirt, the boot alone may be renewed.

Before fitting a new boot smear the area adjacent to the joint with a little Dextagrease Super G.P. lubricant.

(*For* **'SERVICE TOOLS'** *see page J.6*)

SERVICE TOOLS

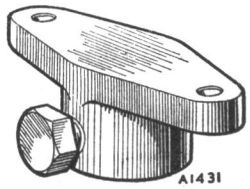
18G 207. Bearing Preload Gauge



18G 207

18G 207 A. Steering Rack Pinion Preload Adaptor

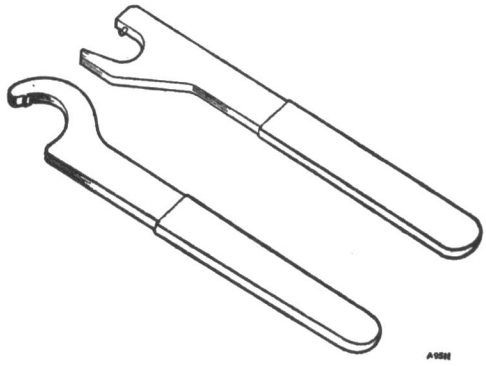
Use this gauge together with the adaptor to test the preloading on the steering pinion during reassembly. Secure the adaptor to the pinion shaft and attach the gauge in the adaptor flange. Move the weight along the bar to the poundage required.



18G 207 A

18G 707. Steering Rack Ball Joint Spanners

Designed to adjust the steering rack ball joint to the correct torque figure, additional leverage must not be used.



18G 707

SECTION K

THE FRONT SUSPENSION

	Section
Castor and camber angles and swivel hub inclination	K.1
Hydrolastic suspension	
Description	H.7
Depressurizing, evacuating, pressurizing	H.8
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Lower arms	K.6
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Struts	K.7
Upper arm	K.5
Swivel hub ball joints	K.4
Swivel hub outer oil seal	K.10
Swivel hubs	K.3
Tools	End of Section

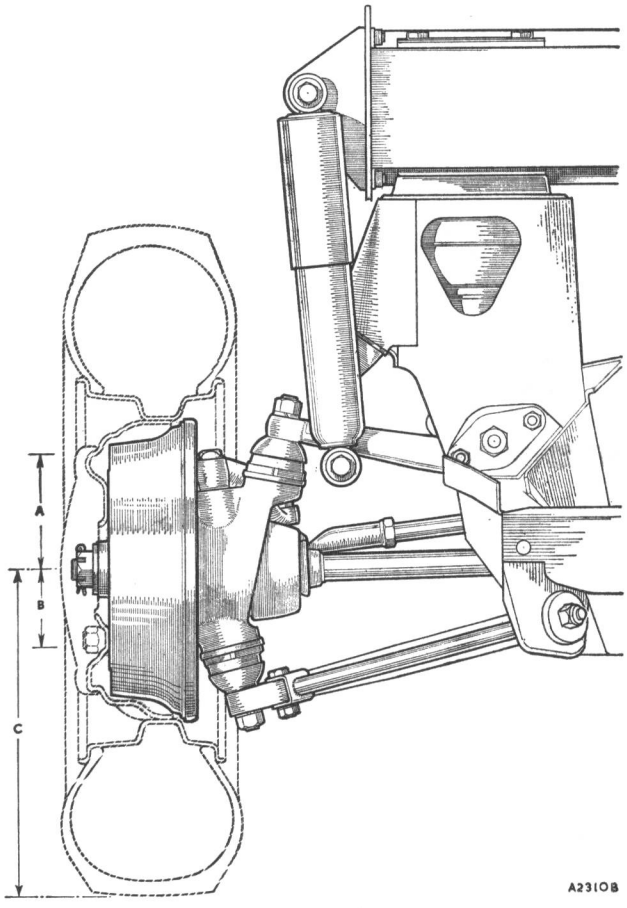


Fig. K.1

The general arrangement of the front suspension: (A) *indicates the maximum upward deflection from normal,* $3\frac{11}{32}$ *in.* (84·93 *mm.*); (B) *the rebound figure,* $2\frac{9}{32}$ *in.* (57·94 *mm.*); (C) *the normal distance above ground surface*

GENERAL DESCRIPTION

The independent front suspension comprises upper and lower suspension arms located in the side-members of the front sub-frame with their outer ends attached by ball joints to the swivel hubs. Rubber cone spring units are mounted in the front sub-frame towers with tubular struts interposed between the springs and the suspension upper support arms. Telescopic dampers are mounted on the upper support arms, with their top spigots anchored on the wing valance.

Maintenance is confined to lubrication as detailed in Section P.3.

WARNING.—When working on the front of the vehicle with the wheels hoisted clear of the ground forceful movement of the road wheels from lock to lock must be avoided. Damage may occur within the steering mechanism when the considerable momentum of the steering-wheel (due to enforced rotation) is suddenly halted.

Section K.1

CASTOR AND CAMBER ANGLES AND SWIVEL HUB INCLINATION

The castor and camber angles and swivel hub inclination are three design settings of the front suspension that have a very important bearing on the steering and general riding of the car. Each of these settings is determined by machining and assembly of the components during manufacture, and are not adjustable.

Should the car suffer damage to the suspension, the angles (as given in **'GENERAL DATA'**) must be verified with a camber, castor, and hub inclination gauge and new parts fitted as found necessary.

Section K.2

SPRING UNITS
(Rubber Suspension)

Compressing

Knock down the locking tabs and slacken both bolts (or nuts if fitted) securing the front sub-frame towers to the engine bulkhead cross-member. Withdraw one bolt (or remove one nut) and move the washer plate to one side to expose the access hole in the cross-member, replace the bolt (or nut), and retighten both bolts (or nuts); do not overtighten.

Assemble Service tool 18G 574 B, making certain that the spindle nut is fully tightened to lock the spindle firmly into the end of the centre screw. Insert the tool through the cross-member, locate the body of the tool over the heads of the two sub-frame bolts, and screw the centre screw of the tool nine complete turns, not more nor less, into the spring unit. Keep the ratchet handle screwed well up the centre screw, clear of the cross-member, during this operation. Operate the ratchet handle to turn the centre nut down to make contact with the body of the tool. Hold the centre screw to prevent

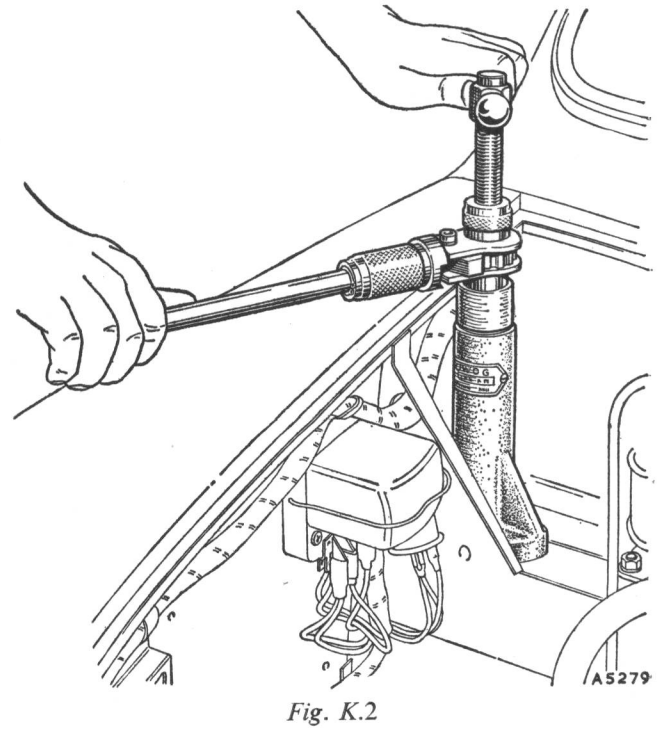


Fig. K.2

The front sub-frame mounting on the engine bulkhead cross-member, showing the method of compressing the spring unit using Service tool 18G 574 B

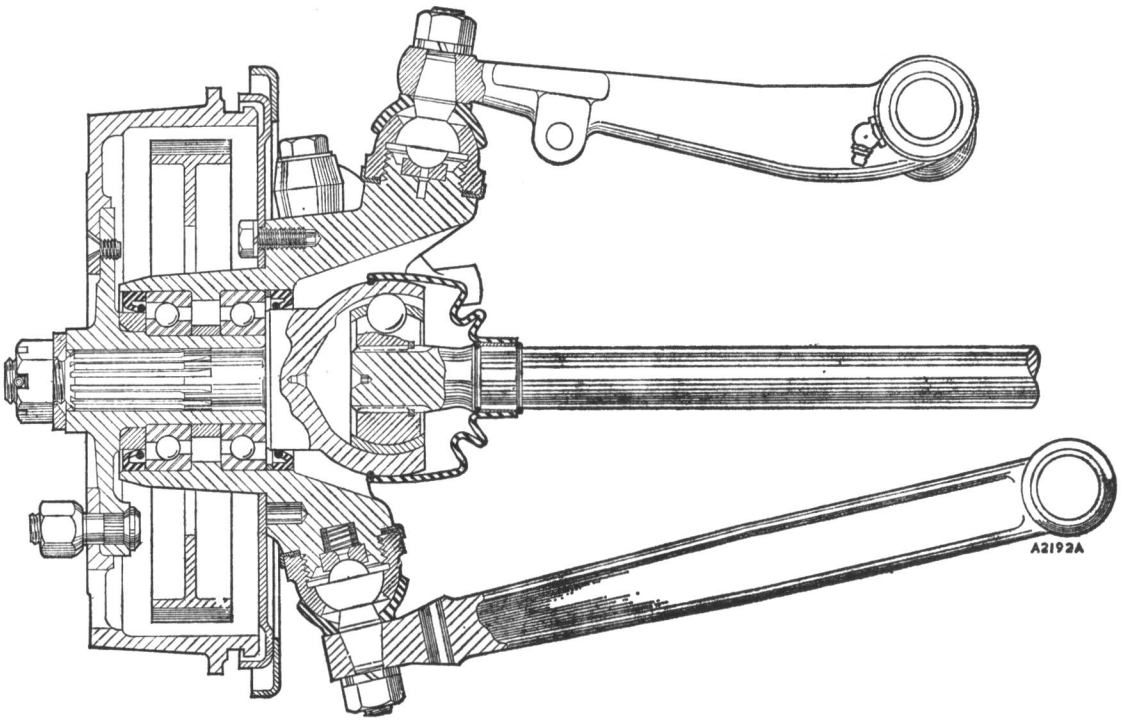


Fig. K.3

A section through the front suspension assembly

further rotation and operate the ratchet handle clockwise to compress the spring unit sufficiently to allow the spring strut to be extracted from the sub-frame tower and the spring unit removed. Do not overcompress the spring.

Removing

Jack up the car after compressing the spring as detailed above and remove the road wheel.

Remove the bump rubber from the sub-frame tower.

Take off the nut securing the upper arm to the swivel hub ball and remove the arm from the ball pin.

With the spring unit compressed the strut can be levered away from its seating in the spring unit.

Detach the hydraulic damper, dismantle the upper arm pivot, and remove the upper arm (see Section K.5).

Hold the centre screw of the compressing tool to prevent it turning, screw the ratchet handle up to release the pressure on the spring unit, and extract the spring from within the sub-frame tower.

Slacken off the compressing nut before attempting to remove the centre screw from the spring unit.

To alter the direction of operation of the ratchet handle rotate the milled sleeve at the inner end of the handle.

Refitting

Ensure that the spring unit is seating correctly on its spigot within the sub-frame tower. Compress the spring, using Service tool 18G 574. Refit the upper arm to the frame and the strut between the arm and the spring. Secure the dust seal over the lip of the nylon seating in the upper arm. Refit the bump rubber to the sub-frame, the hydraulic damper, and release the spring unit from compression.

Section K.3

SWIVEL HUBS

Removing

Jack up the vehicle and remove the road wheel.

Disconnect the ball end from the steering lever and the drive shaft at the inner flexible joint, removing only the four outer nuts from the coupling 'U' bolts. Mark the drive flange and the flexible joint to enable them to be replaced in their original position.

Slacken the brake hose at the frame union and remove it from the brake back-plate.

Release the upper suspension arm from the swivel hub ball pin. Remove the nut and spring washer from the rear end of the lower arm pivot pin and push the pin forward to release the arm. Withdraw the swivel hub assembly complete with the drive shaft.

Dismantling

Unscrew the two brake-drum retaining screws and remove the brake-drum.

Extract the split cotter pin and remove the slotted nut and spacing washer from the end of the drive shaft. Remove the drive shaft with Service tool 18G 304, using adaptor bolts 18G 304 F.

Remove the driving flange from the hub with Service tool 18G 575.

Remove the outer bearing spacer and extract both the inner and outer grease seals.

Drift the inner races of both the inner and outer bearings from the hub bore, and use Service tool 18G 260 together with adaptor 18G 260 H to withdraw the outer races.

The hub bore is machined to form a register between the two bearings; removal must therefore be from their respective sides of the hub bore.

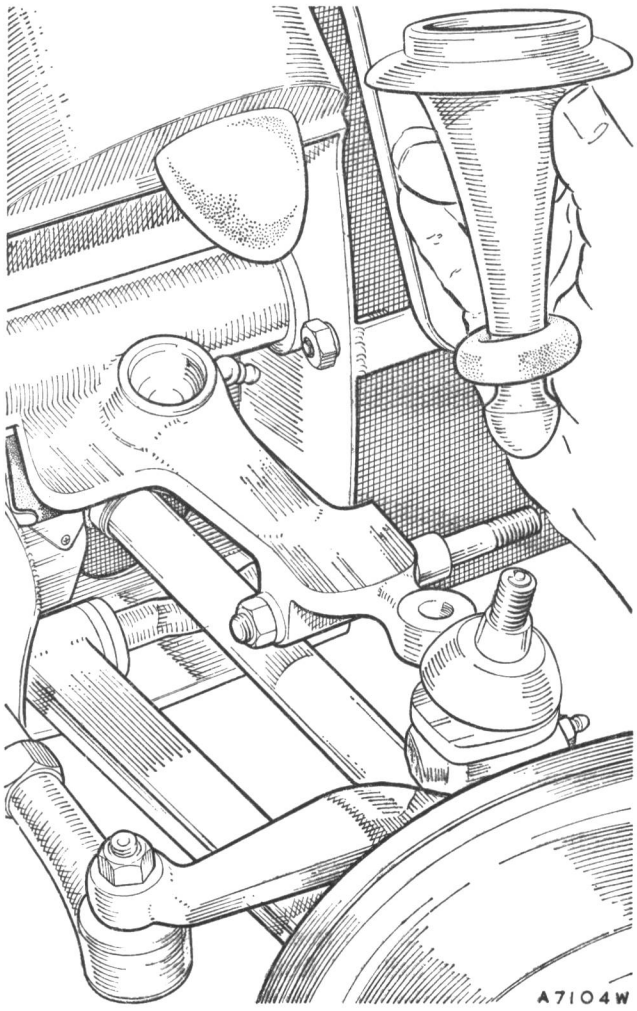


Fig. K.4

The method of removing the spring strut with the spring unit compressed and the upper support arm removed from the hub ball pin

Reassembling

Reassembly is a reversal of the removal procedure, with particular attention given to the following points.

Pack the bearings with grease to Ref. C and make certain that they are fitted with their outer races hard against their register in the swivel hub bore.

When fitting the grease-retaining seals, the outer bearing spacer, and the driving flange washer make certain that they are fitted the right way round; the outer bearing spacer must have the chamfered bore facing outwards and the driving flange washer inwards.

Refitting

Refitting is a reversal of the removal procedure.

When refitting the lower arm follow the procedure given in Section K.6.

Tighten the steering lever ball joint to the torque figure given in **GENERAL DATA'.**

Bleed the hydraulic system when the operations are completed.

Section K.4

SWIVEL HUB BALL JOINTS

Removing

Compress the spring unit as in Section K.2 or depressurize the Hydrolastic system as Section H.8.

Jack up the car and place supports under the front sub-frame side-member. Remove the road wheel and release the tie-rod from the lower arm.

Remove the nut and spring washer securing the upper suspension arm to the ball pin and use a suitable extractor to break the taper joint and draw the arm from the pin. Take off the ball housing dust seal, remove the lubricator, and knock up the tab of the locking washer; unscrew the housing to release the ball and ball seat. The same procedure is used to remove the lower ball joint. Note the spring fitted under the lower ball joint seat.

Refitting

Thoroughly clean all components and refit the ball seat, pin, and ball housing without the packing shims, locking washer, or lower ball joint seat spring. Screw down the ball housing until there is no free movement between the ball and the ball seating, and measure with a feeler gauge the gap between the housing and the swivel hub. Remove the housing and ball pin (refit the spring under the lower joint ball seat), and repack the assembly with grease to Ref. C. Add shims to the value of the feeler gauge measurement less the thickness of the locking washer, ·036 in. (·91 mm.).

The final assembly must have a condition of 'no nip' to ·003 in. (·076 mm.) end float and a further shim must be added to the initial feeler gauge measurement to produce this condition. Replace the locking washer and refit the assembly to the swivel hub. Should there be evidence of excessive end float or tightness the housing shims must be adjusted accordingly.

Use Service tool 18G 372 with adaptor 18G 587 to tighten the ball pin retainer to the correct torque figure (see **'GENERAL DATA'**). Tap up the locking washer on three flats, with one flat adjacent to the brake disc (on Cooper models) to secure the housing.

Replace the dust seal, refit the suspension arm and tighten the ball pin nut to the correct torque figure (see **'GENERAL DATA'**).

Reconnect the tie-rod yoke to the lower arm.

Refit the road wheel.

Release the rubber spring unit from compression or pressurize Hydrolastic system as in Section H.8.

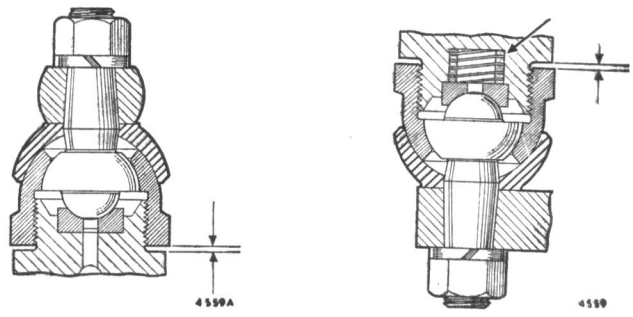


Fig. K.5

A section through the swivel hub ball joints. Take feeler gauge measurements at the positions indicated without the locking washers fitted and without the seat spring fitted to the lower ball joint

Section K.5

UPPER ARM
(Rubber Suspension)

Removing

Compress the spring unit to remove the load from the upper arm as in Section K.2.

Jack up the vehicle and remove the road wheel and the hydraulic damper.

Disconnect the outer end of the arm from the swivel hub ball pin.

Remove the nuts from the arm pivot pin. Take off the front thrust washer retaining plate, extract the washer, and push the pivot pin forward. Remove the rear thrust washer and manoeuvre the arm from the frame.

The needle-roller bearings fitted in each side of the arm bore can be removed with Service tool 18G 581 and new bearings fitted with Service tool 18G 582 and adaptor 18G 582 A. This adaptor will ensure that the new bearings are fitted to the correct depth. Refit the needle-roller bearings with the marked end facing outwards. The nylon seating fitted to the spring strut recess can also be prised out and a new seating fitted.

Refitting

Before the arm is refitted make certain that the hole in the lubricating nipple is clear. Adequately lubricate the components with grease to Ref. C before assembly.

Oil is not a satisfactory lubricant at this point and must not be used.

Place the pivot pin rear thrust washer against the bore of the arm and secure it in this position with its rubber dust seal. Stretch the front dust seal over the arm and insert the pivot pin into the arm bore. With the spring unit compressed, insert the arm into the sub-frame member and locate the spring unit strut in the nylon seating.

The nylon seating cup and the rubber dust seal must be repacked with Dextragrease Super G.P., supplied by BMC Service Ltd. in 1 lb. (·45 kg.) tins under Part No. 97H 2276.

Push the pivot pin into its correct position, refit the front thrust washer, and secure it with the retaining plate. Slide the dust seal over the thrust washer and refit the strut ball end dust seal over the lip of the nylon seating. Replace and tighten up the pivot pin nuts and spring washers.

Reconnect the outer end of the arm to the swivel hub ball pin and secure it with the nut and spring washer.

Refit the hydraulic damper, apply a grease gun to the lubricator on the pivot arm, and refit the road wheel.

Release the spring unit from compression.

Section K.6

LOWER ARM

Removing

Jack up the vehicle and remove the road wheel and hydraulic damper.

Support the suspension beneath the brake-drum; disconnect the outer end of the arm from the swivel hub ball pin and from the tie-rod yoke.

Remove the nut and spring washer from the rear end of the pivot pin and push the pin forward to remove it and release the arm.

Refitting

Refitting is a reversal of the removal sequence. Make certain that the rubber bushes fitted in the bore of the arm are in good condition; new bushes should be fitted if they show signs of wear or deterioration.

The front suspension lower arm must be supported in its normal position (see Fig. K.1) when the lower arm pivot pin is locked up. This will prevent the rubber bushes being subjected to preloading, as would be the case if the pin were locked up with the lower arm hanging down.

Section K.7

SUSPENSION STRUTS
(Rubber Suspension)

From Car No. 44722 the trim height of the vehicle has been raised to give an increased ground clearance by the fitting of circular-section washers between the body of the suspension strut and the shoulder of the knuckle end. When removing a defective strut fitted with one of these washers make certain that a washer is also fitted to the new strut. It is important that only one washer is fitted to each of the four struts.

On later cars with cast-type struts the washers are not necessary and therefore should not be fitted.

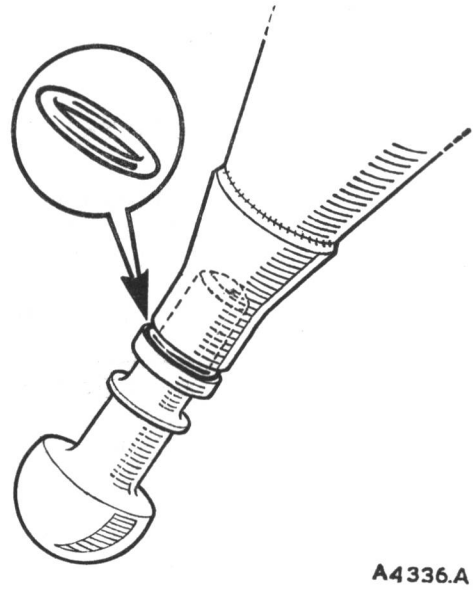


Fig. K.6

A suspension strut, showing the special circular-section washer fitted between the strut body and the knuckle shoulder

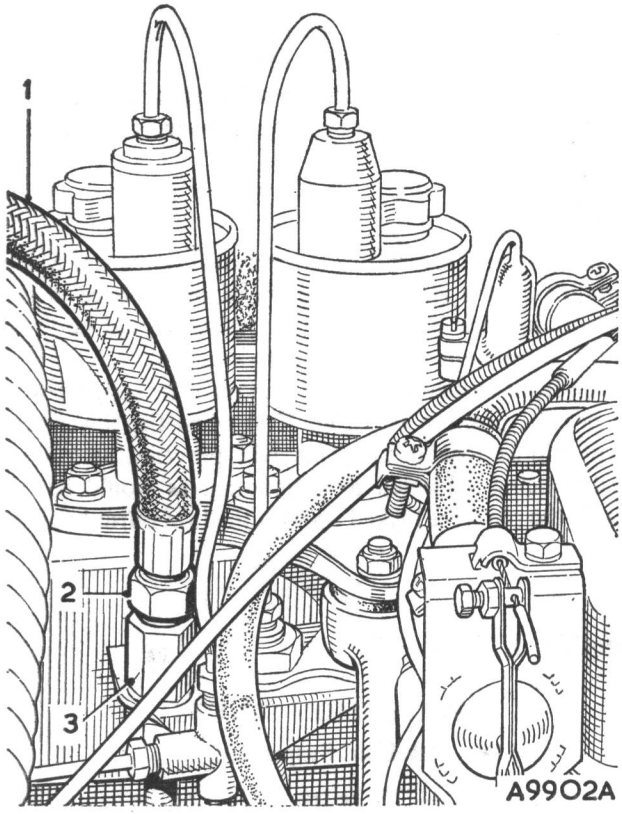


Fig. K.7

The right-hand front displacer hose connector

1. Displacer hose. 2. Hose nut.
3. Connector.

Section K.8

DISPLACER UNITS
(Hydrolastic Suspension)

Removing

(1) Jack up the car and remove the road wheel.
(2) Depressurize and evacuate the Hydrolastic system (see Section H.8).
(3) Release the displacer strut dust seal from the nylon seat and extract the strut from the displacer unit.
(4) Disconnect the displacer hose from the union on the engine bulkhead.
(5) Remove the suspension top arm (see Section K.5).
(6) Push the displacer upwards and remove two screws to release the displacer bracket from inside the sub-frame tower.
(7) Rotate the displacer anti-clockwise and withdraw it from the sub-frame.

Refitting

(8) Reverse the removal instructions.
(9) Rotate the displacer clockwise to lock it into the registers on the locating plate.
(10) Lubricate the strut ball end and the nylon seat with Dextagrease Super G.P. and make sure the dust seal is fitted over the lip of the nylon cup.
(11) Evacuate and pressurize the system (see Section H.8).

Section K.9

UPPER SUSPENSION ARMS
(Hydrolastic Suspension)

Removal

Depressurize the Hydrolastic system as in Section H.8 and follow the instruction in K.5 for arm removal.

Section K.10

SWIVEL HUB OUTER OIL SEAL

The following instructions will permit a leaking outer seal to be replaced when the driving flange is removed.

NOTE.—A bearing overhaul will still require swivel hub removal as in Section K.3

Removal

(1) Remove the hub cover, extract the split pin, and slacken the drive shaft nut.
(2) Slacken the wheel nuts and jack up the vehicle.
(3) Take off the road wheel and remove the brake-drum.
(4) Remove the drive shaft nut and assemble the Service tool 18G 304 and 18G 304 F to the drive flange.
(5) Replace the Service tool centre screw with adaptor 18G 304 P and use the impulse extractor 18G 284 to remove the flange.
(6) Should the outer bearing inner race come away with the driving flange, it can be removed with Service tool 18G 705 and adaptor 18G 705 B.

Refitting

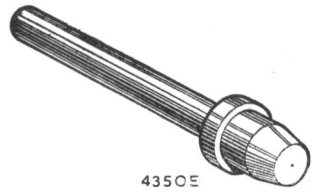
(7) Refit the inner bearing race (if extracted).
(8) Fit the new seal and apply a suitable amount of lubricant to the lip to prevent burning.
(9) Insert the outer bearing distance piece into the seal with the chamfered bore to the outside.
(10) Assemble the drive flange to the hub, drifting it into position gently, turning the flange 180 degrees several times to align the bearing distance piece with the flange boss.
(11) Refit the brake-drum.
(12) Refit the drive shaft washer, chamfered bore facing inward, and replace the nut.
(13) Tighten the shaft nut to the torque figure given in **'GENERAL DATA'** and secure with the split pin.

SERVICE TOOLS

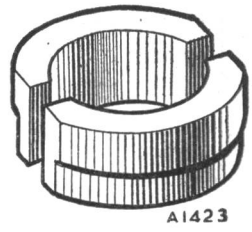
18G 260. Hub Bearing Outer Race Remover (basic tool)

18G 260 H. Front Hub Drive Flange Bearing Outer Race Remover Adaptor

An adaptor designed for use in conjunction with basic tool 18G 260 for the removal of the outer bearing races from the front hub.



18G 260

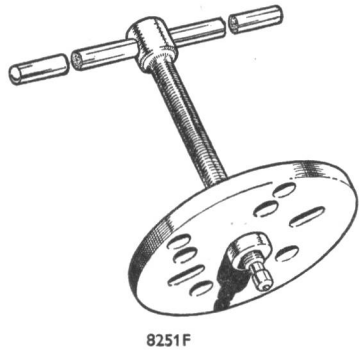


18G 260 H

18G 304. Front and Rear Hub Remover (basic tool)

18G 304 F. Front and Rear Hub Remover Bolt Adaptor

Two of the adaptor bolts 18G 304 F are required to remove the drive shaft from the hub.

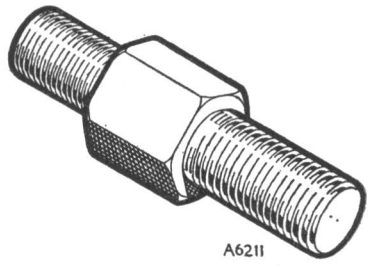


18G 304

18G 304 F

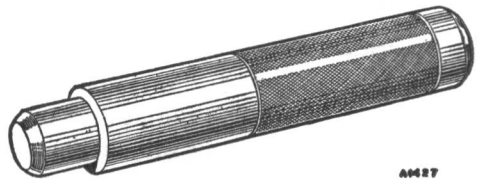
18G 304 P. Drive Flange Remover Adaptor

For use in conjunction with Service tool 18G 304, 18G 304 F, and 18G 284 to remove the driving flange without dismantling the swivel hub.



18G 304 P

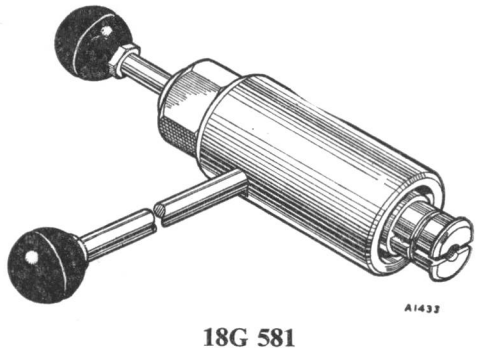
18G 575. Front Hub Drive Flange Remover



18G 575

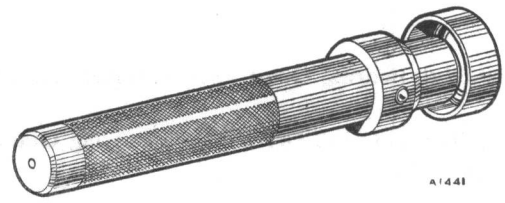
18G 581. Front Suspension and Idler Gear Needle Bearing Remover

This tool will make the removal of a defective needle bearing from the bore of the upper suspension arm an easy operation, and at the same time avoid damaging the bore.



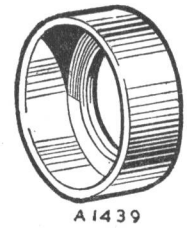
18G 581

18G 582. Front Suspension and Idler Gear Needle Bearing Replacer



18G 582

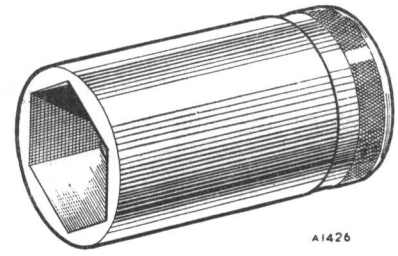
18G 582 A. Front Suspension and Idler Gear Needle Bearing Replacer Adaptor



18G 582 A

18G 587. Swivel Hub Ball Pin Nut Spanner

This socket must be used with torque wrench 18G 372 in order that the correct torque figure may be applied to the swivel hub ball nut on reassembly.

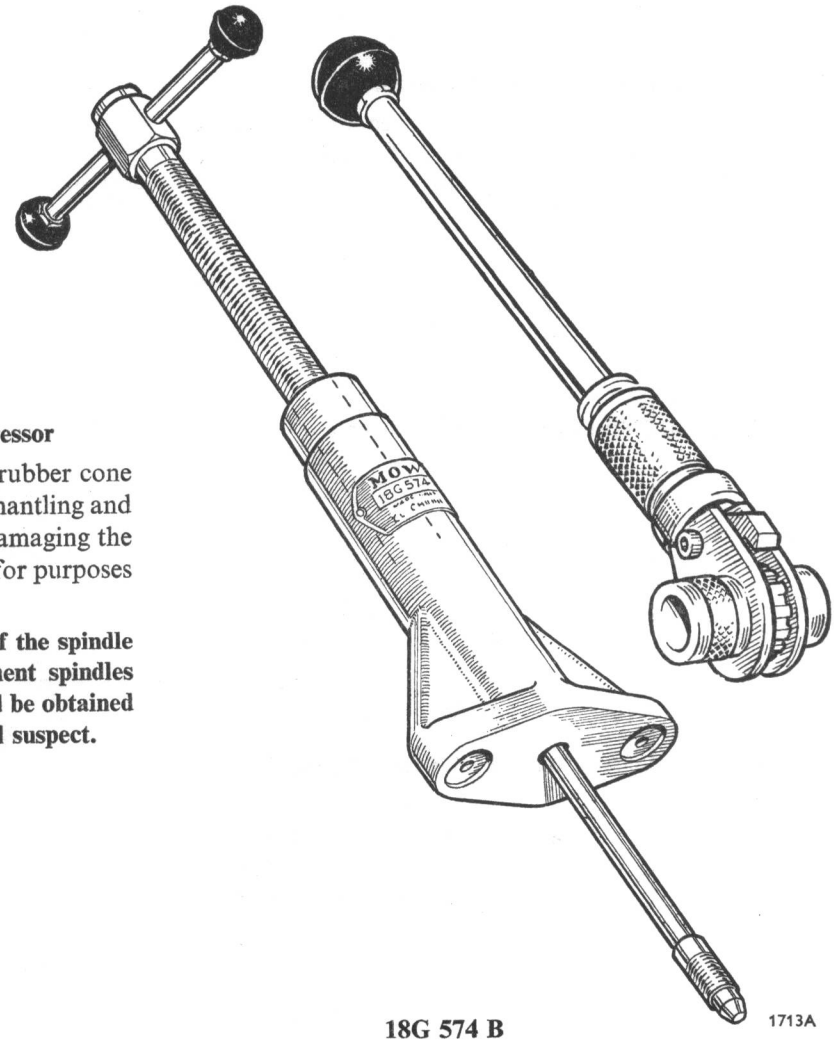


18G 587

18G 574 B. Suspension Rubber Spring Compressor

This tool will enable the front suspension rubber cone spring to be compressed with ease during dismantling and reassembly of the suspension arms without damaging the thread of the nut welded into the spring unit for purposes of spring compression.

WARNING.—This tool must not be used if the spindle thread is badly worn or damaged. Replacement spindles (Part No. 18G 574 A) are available and should be obtained if the threads on the existing spindle are at all suspect.



18G 574 B

1713A

SECTION L

THE HYDRAULIC DAMPERS
(TELESCOPIC)

Section

General description

Dampers

Front L.1

Rear L.2

Rear (Moke) L.4

Priming L.3

GENERAL DESCRIPTION

Telescopic hydraulic dampers are fitted at both front and rear of the vehicle. All working parts are immersed in oil and the dampers are set before dispatch. They cannot be adjusted or refilled with fluid; when defective they must be replaced with new units.

Some indication of the condition of a damper may be gained by holding the damper vertically with the bottom lug in a vice and fully extending and compressing the unit several times to expel any air from the pressure cylinder chamber. When this has been done the movement should be slow and even over the whole range; if it is not, renew the unit.

Section L.1

FRONT DAMPERS

Jack up the vehicle and remove the road wheel.

Support the suspension assembly beneath the brake-drum, remove the upper and lower mounting securing nuts, and pull the damper from its mounting spigots.

Make certain that the rubber bushes are in good order; replace them with new bushes if they show signs of deterioration.

Before refitting the damper to the car hold the damper vertically in a vice, gripping it by the bottom mounting eye, and fully extend and compress the damper about six times to expel any air from the pressure cylinder chamber. The damper must be retained in an upright position until refitted.

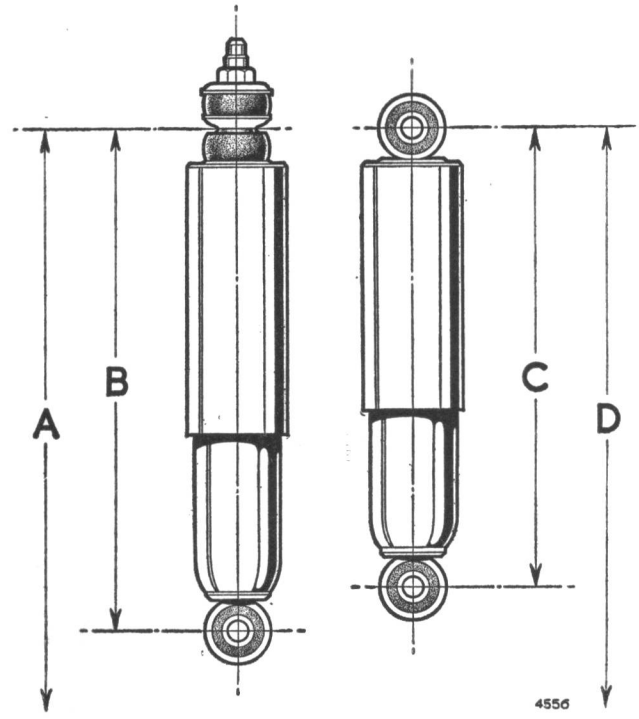


Fig. L.1

The hydraulic dampers

Rear

A. Extended length 15 3/16 in. (385·76 mm.). Van only 16 1/8 in. (409·6 mm.).

B. Compressed length 9 9/16 in. (242·89 mm.). Van only 10 in. (254 mm.).

Front

C. Compressed length 8 1/2 in. (215·90 mm.).

D. Extended length 12 3/4 in. (323·85 mm.).

Section L.2

REAR DAMPERS

Remove the upper damper mounting nuts from inside the luggage boot. To gain access to the left-hand damper mounting remove the fuel tank as detailed in Section D.1.

On early-type cars not fitted with a drain tap in the fuel tank the left-hand damper mounting can be released by undoing the tank strap and gently lifting the tank towards the centre-line of the car, pivoting about the rubber fuel line connector at its forward end without detachment at this point. If this method is adopted it must be undertaken with extreme care, otherwise the rubber connecting hose may be damaged.

Jack up the vehicle and remove the road wheel. Take off the lower mounting nut and washer, collapse the damper, and remove it from its anchorage point on the radius arm.

Retain the damper in an upright position after removal from the car.

Make certain that the rubber bushes are in good condition; fit new bushes if they are worn or damaged.

Before refitting the damper to the car hold the damper vertically in a vice, gripping it by the bottom mounting eye, and fully extend and compress the damper about six times to expel any air from the pressure cylinder chamber. The damper must be retained in an upright position until refitted.

When refitting the rear dampers make certain that the rubber cone spring and the spring strut are correctly located on their individual spigots whilst the radius arm is being raised to reconnect the upper end of the damper. Failure to observe this instruction may result in a vehicle having the appearance of being trimmed too high at the back, and would probably damage both the spring and the spring strut beyond recovery.

Section L.3

PRIMING

If it is suspected that air is present in a hydraulic damper, remove the damper from the vehicle and stand it in a vertical position for approximately five hours.

After this period prime the damper as follows.

Armstrong

Hold the damper in a vertical position, extend it to its full travel, and then compress slowly. Continue to extend and compress until no free travel can be felt when changing the direction of stroke.

Girling

Hold the damper with the dirt shield uppermost at an angle of 15 to 20 degrees to the vertical. Extend the damper about 3 in. (76 mm.) very slowly, and then compress fully.

Rotate the dust shield during this operation and repeat the sequence, extending very slowly and compressing until all free play has disappeared. **Do not fully extend the damper during this process.**

New dampers need only be held in a vertical position for a few minutes before priming as described above. Always place dampers in a vertical position after priming.

Section L.4

REAR DAMPERS

(Moke)

Removing

(1) Jack up and remove the road wheel.

(2) Remove the cover from the upper mounting point inside the vehicle.

(3) Remove the nuts from the upper and lower mounting points, collapse the damper, and pull it from its anchorage on the radius arm.

SECTION M

THE BRAKING SYSTEM

	Section
General description	
Bleeding the hydraulic system	M.4
Brake-shoe adjustments	M.2
Brake-shoe assemblies	M.8
Front wheel cylinder assembly	M.6
Hand brake adjustment	M.3
Hand brake cables	M.11
Maintenance	M.1
Master cylinder	M.5
Pressure regulating valve	M.9
Rear wheel cylinders	M.7
Removing the flexible hose	M.10
Two-leading-shoe brakes	M.12

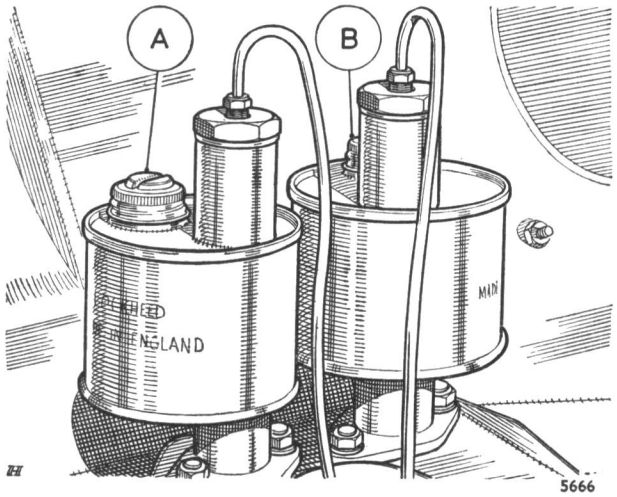


Fig. M.1

(A) *The brake and* (B) *the clutch master cylinder and hydraulic fluid reservoir*

GENERAL DESCRIPTION

The Lockheed hydraulic brake operating equipment comprises a combined fluid supply tank and master cylinder in which the hydraulic pressure is generated and wheel cylinders which operate the brake-shoes. Steel pipe lines, unions, and rubber hoses convey the hydraulic pressure from the master cylinder to a single wheel cylinder in each brake-drum. A valve is fitted in the fluid line to limit the pressure to the rear wheel cylinders.

Section M.1

MAINTENANCE

Periodically examine the quantity of brake fluid in the master cylinder. The level should be kept ¼ in. (6·3 mm.) below the bottom of the filler neck, but not higher. The necessity for frequent topping up is an indicaton of a leak in the system which should at once be traced and rectified.

Adjust the brake-shoes to compensate for wear of the linings. The need for this is shown by the pedal going down almost to the floorboards before solid resistance is felt. For foot brake adjustments see Section N.2.

Section M.2

BRAKE-SHOE ADJUSTMENTS

As the brake linings wear the foot pedal will travel nearer to the floorboards before the brakes come into operation. When the travel becomes excessive the brake-shoes must be adjusted to bring the linings into closer relation with the brake-drum.

One common adjuster controlling the adjustment on both the leading and trailing brake-shoes is located on the back of each brake back-plate.

Jack up the car and turn the adjuster screw in a clockwise direction until the brake-drum is locked, then slacken the screw until the shoe is just free of the drum. The drum should be free to rotate without rubbing.

Repeat this adjustment on the other three road wheels.

Section M.3

HAND BRAKE ADJUSTMENT

The hand brake operates on the shoes in the rear brake drums and is automatically adjusted when the hydraulic brake shoe adjustment is carried out.

If hand brake travel is excessive, the rear brake shoes must be adjusted to the drums. Chock the front wheels and raise the rear of the car until both wheels are free to rotate. Set the hand brake to the 'off' position and adjust the shoes as detailed in Section M.2.

With the shoes correctly adjusted, apply the hand brake until the pawl within the lever engages with the third notch on the ratchet. Turn the cable adjusting nuts at the hand brake lever until it is just possible to rotate each wheel by heavy hand pressure. It is most important that the road wheels offer equal resistance in order to obtain full braking power. Return the lever to the 'off' position and check that both wheels rotate freely. If either wheel binds after correct adjustment has been made, check that the brake shoe pull-off springs are correctly fitted (Fig. M.6) and that the wheel cylinders are not partially

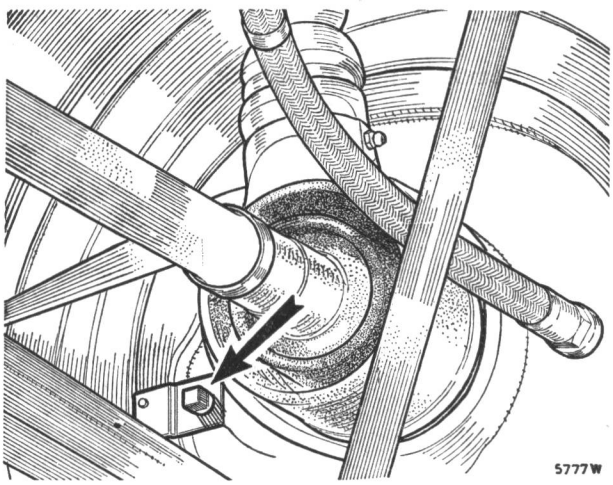


Fig. M.2

The front brake-shoe adjuster. One square-headed adjuster is provided on each of the four brake back-plates

seized. Check the hand brake cable sector pivots for stiffness in operation, and lubricate with engine oil.

Rectify fault and carry out complete readjustment.

Section M.4

BLEEDING THE HYDRAULIC SYSTEM (Expelling Air)

Bleeding the braking system is not a routine maintenance job and should only be necessary when some portion of the hydraulic equipment has been disconnected or the fluid level allowed to fall so low that air has entered the system through the master cylinder.

Fill the fluid reservoir with Lockheed Super Heavy Duty Brake Fluid (or, if not available, with fluid to Specification S.A.E. 70.R3) and keep it at least half-full throughout the bleeding operation, otherwise air will be drawn into the system necessitating a fresh start.

Attach the bleeder tube to the wheel cylinder bleeder screw and immerse the free end of the tube in a clean jar containing a little brake fluid.

Open the bleed nipple one full turn. Depress the brake pedal slowly and allow it to return without assistance. Repeat this pumping action with a slight pause before each depression of the pedal. When the fluid entering the jar is completely free of air bubbles hold the pedal firmly against the floorboards and tighten the bleeder screw.

This process must be repeated on each bleed screw at the three remaining back-plates.

After bleeding top up the fluid reservoir to its correct level.

NOTE.—Clean fluid bled from the system must be allowed to stand until it is clear of air bubbles (approximately 24 hours) before it is used again. Dirty fluid must be discarded.

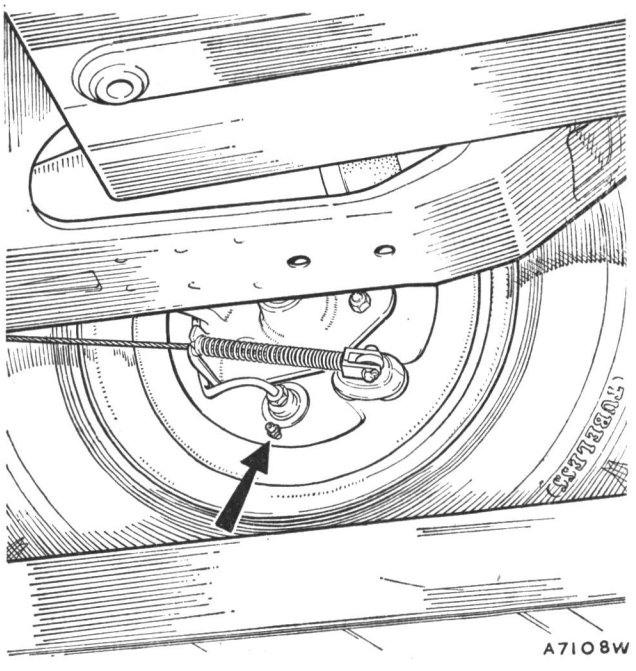


Fig. M.3

A rear wheel cylinder bleeder screw. One bleeder screw is provided on each of the four brake back-plates

Section M.5

MASTER CYLINDER

Construction and operation

The master cylinder piston is backed by a rubber cup and is normally held in the 'off' position by a return spring. Immediately in front of the cup, when it is in the 'off' position, is a compensating orifice connecting the cylinder with the fluid supply. This port allows free compensation for any expansion or contraction of fluid, thus ensuring that the system is constantly filled; it also serves as a release for additional fluid drawn into the cylinder during brake applications.

Pressure is applied to the piston by means of the push-rod attached to the brake pedal.

The reduced skirt of the piston forms an annular space which is filled with fluid from the supply tank via the feed hole. Leakage of fluid from the open end of the cylinder is prevented by the secondary cup fitted to the flange end of the piston.

By releasing the brake pedal after application the piston is returned quickly to its stop by the return spring, thus creating a vacuum in the cylinder; this vacuum causes the main cup to collapse and pass fluid through the small holes in the piston head from the annular space formed by the piston skirt. This additional fluid finds its way back to the reserve supply tank under the action of the brake return springs through the outlet valve and compensating orifice until the system finally comes to rest. If the compensating orifice is covered by the piston cup when the system is at rest pressure will build up as a result of brake application. The combination inlet and outlet check valve in the head of the cylinder bore prevents fluid pumped out from the cylinder when 'bleeding' the system from returning to the cylinder, thus ensuring a fresh charge being delivered at each stroke of the pedal.

Removing

Remove the split pin and withdraw the clevis pin securing the master cylinder push-rod to the pedal lever.

Disconnect the pressure pipe union from the master cylinder, remove the two bolts securing the cylinder to

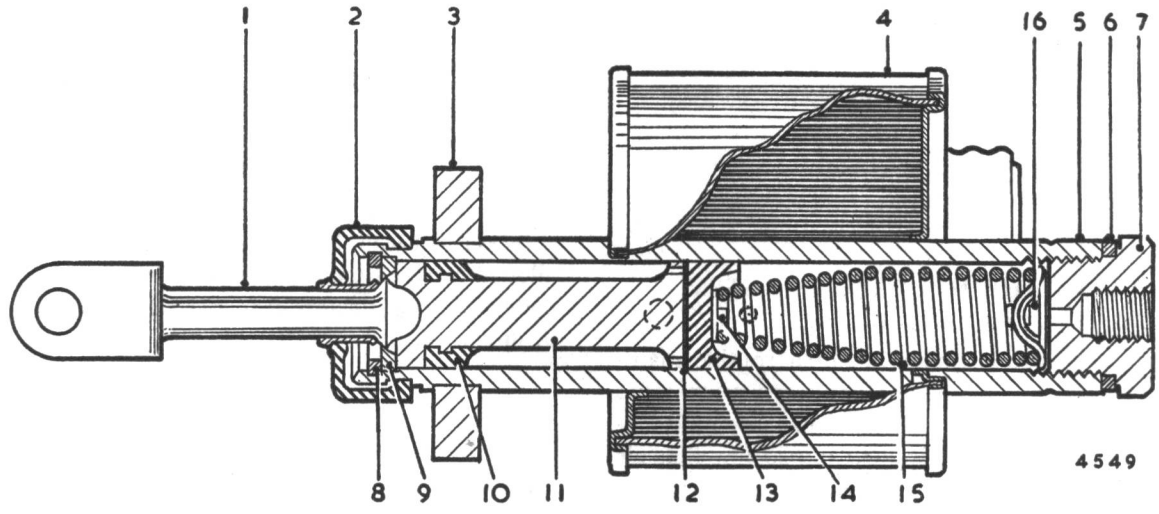


Fig. M.4

A section through the brake master cylinder

1. Push-rod.
2. Rubber boot.
3. Mounting flange.
4. Supply tank.
5. Body.
6. Washer.
7. End plug.
8. Circlip.
9. Stop washer.
10. Secondary cup.
11. Piston.
12. Piston washer.
13. Main cup.
14. Spring retainer.
15. Return spring.
16. Non-return valve.

the bulkhead, and then withdraw the assembly complete from the car.

Dismantling

Remove the filler cap and drain out the fluid.

Pull back the rubber dust cover, remove the circlip with a pair of long-nosed pliers, and the push-rod and dished washer can then be removed.

Withdraw the remaining parts from the cylinder barrel.

To remove the secondary cup from the piston carefully stretch the cup over the end flange of the piston, using only the fingers.

Reassembling

Clean all parts thoroughly, using Lockheed Super Heavy Duty Brake Fluid for all rubber components. All traces of fuel or trichlor-ethylene used for cleaning the metal parts must be removed before assembly.

Examine all rubber parts for damage or distortion. It is usually advisable to renew the rubbers when rebuilding the cylinder. Dip all the internal parts in brake fluid and assemble them wet.

Stretch the secondary cup over the end flange of the piston with the lip of the cup facing towards the opposite end of the piston. When the cup is in its groove work it round gently with the fingers to make sure it is correctly seated. Fit the valve cup and body to the return spring.

Insert the return spring into the barrel, making sure that the spring seat is positioned on the end of the spring to receive the piston main cup.

Insert the main cup, lip first, taking care not to damage or turn back the lip, and press it down onto the spring seat.

Replace the dished washer with its concave side in contact with the main cup.

Insert the piston, taking care not to damage or turn back the lip of the secondary cup.

Push the piston down the bore and replace the push-rod, retaining circlip, and rubber dust cover.

Refitting

Secure the master cylinder by means of the two bolts to the bulkhead and refit the pressure pipe union to the cylinder barrel.

Line up the push-rod yoke with the pedal lever and secure the yoke to the lever with the clevis pin and circlip.

Check the brake-shoe adjustment as detailed in Section M.2.

Refill and bleed the system as in Section M.4.

Check the system for leaks with the brakes fully on.

Section M.6

FRONT WHEEL CYLINDER ASSEMBLY

Removing

Jack up the car, remove the road wheel, and thoroughly clean the brake back-plate.

Disconnect the flexible fluid supply hose as detailed in Section M.10.

Unscrew and remove the bleed screw. Remove the circlip and dished washer from the wheel cylinder boss protruding through the brake back-plate.

Take out the two brake-drum retaining screws and withdraw the drum. Pull the brake-shoes apart and extract the cylinder.

Examining

Remove the dust seals from the ends of the cylinder and extract both pistons. The rubber piston seals can be removed from their recesses and new seals fitted by using the fingers only.

Do not clean the rubber parts with anything other than the correct brake fluid. All traces of fuel, etc., used for cleaning metal parts must be removed before reassembly.

Refitting

The procedure for refitting a front wheel cylinder is a reversal of the removal sequence. In addition, attention must be given to bleeding the hydraulic system and adjusting the brake-shoes as detailed in Sections M.4 and M.2.

Section M.7

REAR WHEEL CYLINDERS

Removing

Jack up the car under the rear sub-frame, remove the road wheel, and thoroughly clean the brake back-plate.

Disconnect the flexible fluid supply hose as detailed in Section M.9.

Unscrew and remove the bleed screw. Remove the circlip and dished washer from the cylinder boss protruding through the brake back-plate.

Take out the two brake-drum retaining screws and withdraw the drum. Remove the brake-shoes (see Section M.8) and extract the cylinder.

Examining

Remove the dust seals from the ends of the cylinder and extract both pistons. The rubber piston seals should be removed and new seals fitted by using the fingers only.

Do not clean the rubber parts with anything other than the correct brake fluid. All traces of fuel, etc., used for cleaning metal parts must be removed before reassembly.

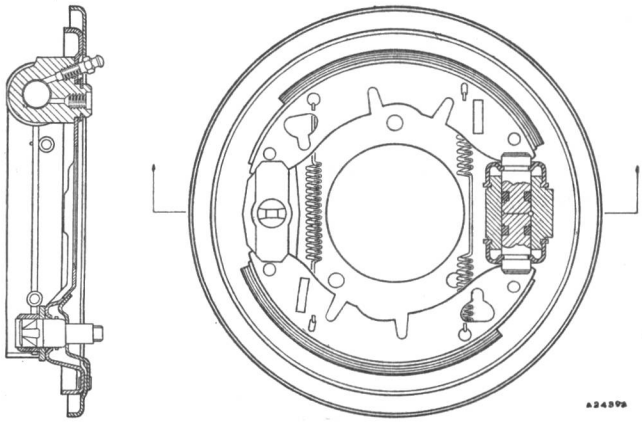


Fig. M.5

The right-hand front brake assembly, showing the fitted positions of the leading and trailing brake-shoes, with the pull-off springs anchored in the correct holes in the shoe web

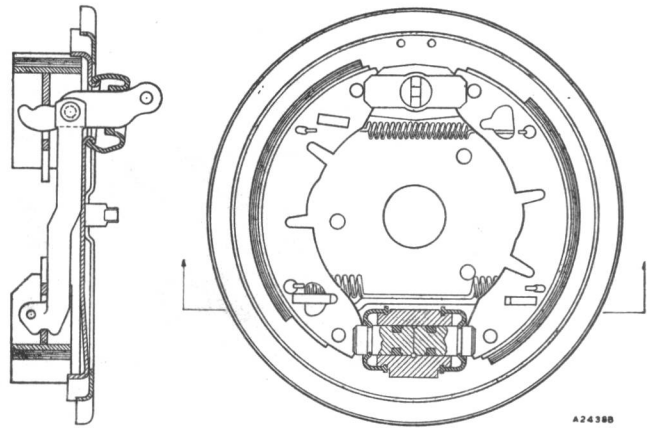


Fig. M.6

The right-hand rear brake assembly, showing the pull-off springs anchored in the correct holes in the shoe web

Refitting

The procedure for refitting a rear wheel cylinder is a reversal of the removal sequence. In addition, attention must be given to bleeding the hydraulic system and adjusting the brake-shoes as detailed in Sections M.4 and M.2.

Section M.8

BRAKE-SHOE ASSEMBLIES

Removing front shoes

Jack up the car and remove the road wheel.

Unscrew the two retaining screws and remove the brake-drum.

Note and mark the position in which the pull-off springs are fitted. Release the springs from the shoe web and remove the shoes from the back-plate.

NOTE.—Do not operate the brake pedal with the shoes removed from the back-plate.

Refitting is a reversal of the above procedure; make sure that the pull-off springs are anchored in their correct holes in the shoe web (see Fig. M.5) and that the brake-shoes register correctly in the slotted end of the wheel cylinder piston and in the adjuster tappets.

Removing rear shoes

Chock the front road wheels and set the hand brake in the 'off' position.

Jack up the car under the rear sub-frame and remove the road wheel.

Unscrew the two brake-drum retaining screws and remove the drum.

Note and mark the position in which the pull-off springs are fitted. Release the springs and remove the shoes.

NOTE.—Do not operate the brake pedal with the shoes removed from the back-plate.

Refitting is a reversal of the removal procedure; make sure that the pull-off springs are anchored in their correct holes in the shoe web and that the shoes on the front

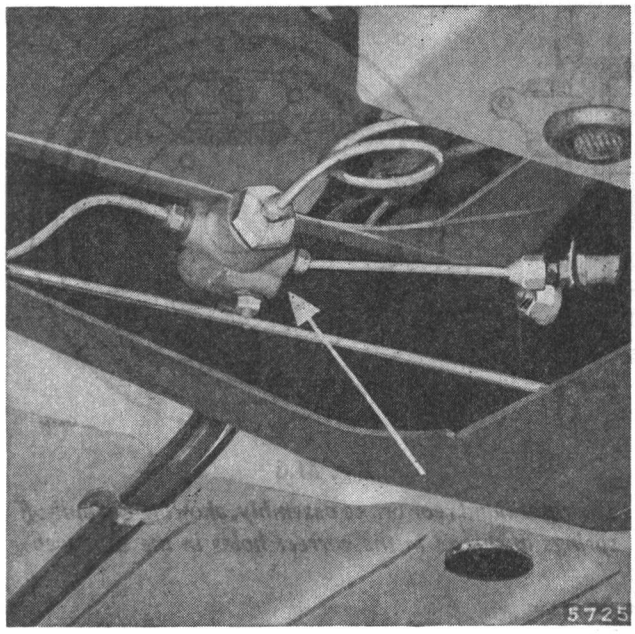


Fig. M.7
The hydraulic pressure regulating valve

brake assembly are fitted with their leading and trailing edges as shown in Figs. M.5 and M.6. Ensure that the brake-shoes register correctly in the slotted end of the wheel cylinder piston and in the adjuster tappets.

Relining

If it becomes necessary to renew the full set of brake linings due to excessive wear it is essential that the material used for relining is the same as originally specified or of an approved alternative, otherwise the present front to rear brake balance will be adversely affected.

Under no circumstances can linings of varying manufacture, type, or characteristic be tolerated at the different brake stations.

Any divergence from these stipulations may give rise to serious consequences due to out-of-balance braking.

For information as to approved lining materials refer to **'GENERAL DATA'.**

Do not reline the brake-shoes with different types of lining.

Owing to the need for the brake linings to be perfectly concentric with the brake-drums, special precautions must be taken when relining the shoes. It is not recommended that relining be undertaken unless all the specialist facilities are available. We advise the use of replacement shoes obtainable from BMC Service Ltd. Renewal should be carried out in axle sets to ensure even braking conditions.

After riveting the new linings to the brake-shoes it is essential that any high-spots should be removed before replacement on the back-plate.

When new linings are fitted turn the adjusters to their fully 'off' position before attempting to refit the brake-drums over the new linings. The hand brake must also be in the fully released position.

Do not allow grease or paint to come into contact with the brake linings.

Do not clean the rubber parts with anything other than Lockheed Super Heavy Duty Brake Fluid. All traces of fuel, etc., for cleaning metal parts must be removed before reassembly.

Section M.9

PRESSURE REGULATING VALVE

A regulating valve is fitted in the brake fluid line (see Fig. M.7) and is designed to control the hydraulic pressure to the rear brake-shoe operating cylinders. When the pressure in the fluid line reaches a predetermined figure the valve will close and prevent any pressure in excess of this being applied to the rear brakes; all additional pressure is transferred to the wheel cylinders operating the front brakes.

Removing

Disconnect the three pressure lines from their connections on the valve body and remove the nut and washer to release the valve from its location on the rear sub-frame front cross-member.

Dismantling

Clean the exterior of the assembly.

Unscrew and remove the end plug and sealing washer.

Extract the valve assembly and the return spring.

Examine the rubber seals; if they are worn or damaged a new piston and seal assembly must be fitted.

Reassembling

Thoroughly clean and lubricate the body bore and all the component parts with Lockheed Super Heavy Duty Brake Fluid. Fit a new taper seal and piston seal in the positions shown in Fig. M.8; make certain that the taper seal is fitted with the small diameter positioned to enter the valve bore first.

Refit the return spring and the valve assembly, and secure in position with the end plug and sealing washer.

Refitting

Refit the assembly to the sub-frame cross-member, reconnect the three pressure lines, and bleed the system as detailed in Section M.4.

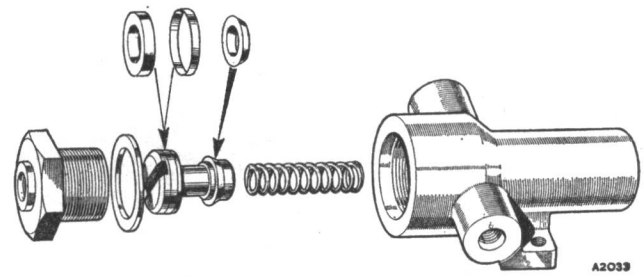


Fig. M.8
The hydraulic pressure regulating valve components

Section M.10

REMOVING THE FLEXIBLE HOSE

Do not attempt to release a flexible hose by turning either end with a spanner; it should be removed as follows.

Unscrew the metal pipe line union nut from its connection to the hose.

Hold the hexagon on the flexible hose and remove the locknut securing the flexible hose union to the bracket.

Unscrew the flexible hose from the cylinder.

Section M.11

HAND BRAKE CABLES

Removing

Chock the front road wheels and set the hand brake lever in the 'off' position.

Remove the cable adjusting nuts and remove the cable fairlead located in the centre of the floor and to the rear of the front seat. Draw the cable through the floor from underneath the car and release the cable from the guide channel on the rear sub-frame front cross-member.

Jack up the car under the rear sub-frame and remove the road wheel.

Prise the guide tube from the clip on the radius arm and pull it from its anchorage hole in the arm boss. On later models remove the nut securing the cable swivel sector to the radius arm and allow the sector to be removed with the cable. Draw the cable through the frame and release it from the actuating lever on the brake back-plate.

When fitting a new cable make certain that the corners of the sector are 'nipped' as shown in Fig. M.9.

Refitting

Refitting is a reversal of the removal procedure. Make certain that the guide channel is well lubricated and that the guide tube (fitted to early models only) is pushed into its anchorage hole and secured firmly in position with its clip on the radius arm.

Readjust the hand brake as detailed in Section M.3.

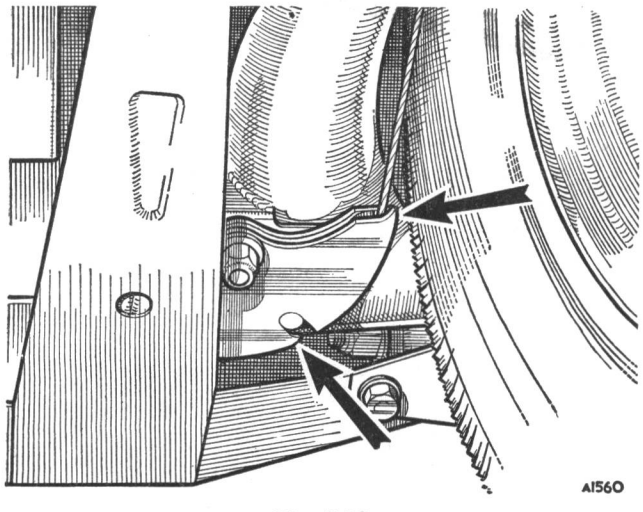


Fig. M.9

The hand brake cable sector mounted on the rear radius arms. Only the corners indicated must be 'nipped' to position the cable

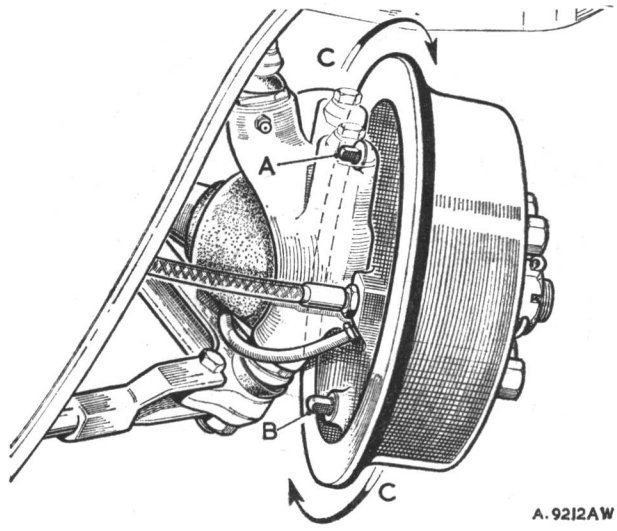


Fig. M.10

The adjusters for the two-leading-shoe front brakes

Section M.12

TWO-LEADING-SHOE FRONT BRAKES

Each front brake has two squared adjusters projecting from the rear face of the back-plate, one adjuster for each brake-shoe.

Adjustment

(1) Jack up the car and deal with one adjuster at a time.
(2) Turn the adjuster in the same direction as the forward rotation of the front wheel until the drum is locked, then back off the adjuster the minimum amount necessary to allow the drum to rotate freely.
(3) Spin the wheel and apply the foot brake firmly to centralize the shoe.
(4) Re-check the adjustment, and repeat the complete operation with the other adjuster.
(5) Carry out the same sequence on the other front wheel.

Dismantling

(6) Jack up the car and remove the front road wheel.
(7) Back off both adjusters completely, extract the two retaining screws, and remove the brake-drum.
(8) The tips of the brake-shoes are retained on the wheel cylinder pistons by spring-loaded hooks, one to each shoe. Withdraw the hooks from their registers in the pistons and turn them to one side.
(9) Mark the position of the shoe return springs in the shoes, and note which end of the shoe is fitted to the wheel cylinder.

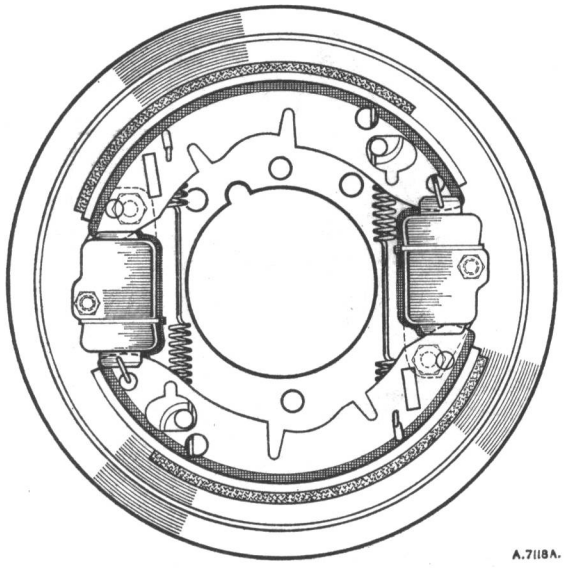


*Fig. M.*11

The left-hand front brake assembly, showing the fitted position of the shoes and pull-off springs

(10) Lift out one shoe from the recesses in the wheel cylinder, and pivot against the pressure of the return spring. Manœuvre the assembly of the shoes and springs over the front hub.

(11) Wire the pistons to the wheel cylinder castings to prevent them from being accidentally pushed out.

Reassembly

(12) Reassembly is a reversal of the dismantling procedure.

(13) Ensure that the shoes are replaced the correct way round and the return springs are fitted in their correct positions.

(14) The shoes must register correctly in the grooves in the pistons and pivot points.

Wheel cylinder removal

(15) Remove the brake-shoes as described under **'Dismantling'.**

(16) Disconnect the flexible brake hose from the front wheel cylinder. Unscrew the two union nuts and detach the pipe bridging the two wheel cylinders.

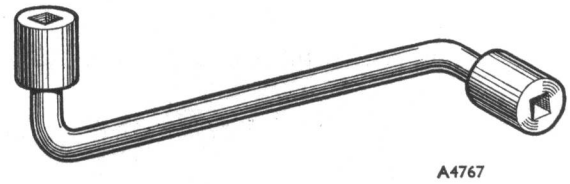
(17) Remove the two hexagon screws retaining each wheel cylinder to the backplate and detach the wheel cylinders.

(18) Note, on replacement, that the piston of the wheel cylinder faces in the same direction as the forward rotation of the brake-drum and that the bleed screw is fitted to the rearmost wheel cylinder.

SERVICE TOOLS

18G 619. Brake Adjusting Spanner

The use of this spanner obviates damage to the adjusters, enables the brakes to be adjusted more speedily and effectively, and removes the possibility of damaged knuckles and fingers.



18G 619

SECTION N

THE ELECTRICAL SYSTEM

	Section
General description	
Battery	
Dry-charged, preparation for service	N.2
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New, unfilled, uncharged, preparation for service	N.3
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Headlamps	N.10
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Windshield wiper	N.9
Windshield wiper (Moke)	N.21
Wiring diagram	End of Section

GENERAL DESCRIPTION

The 12-volt electrical equipment incorporates compensated voltage control for the charging circuit. The positive-earth system of wiring is employed.

The battery is located in the floor of the luggage boot of the saloon model, beneath the loading platform of the Countryman or Traveller, behind the passenger's seat of the Van, and inside the body right-hand side-member of the Moke.

The dynamo is mounted on the right of the cylinder block and driven by an endless belt from the crankshaft pulley. The dynamo mounting is adjustable to enable the correct belt tension to be maintained.

The voltage control unit adjustment is sealed and should not normally require attention. The fuses are carried in external holders mounted in an accessible position on the right-hand side of the engine compartment together with spare fuses.

The starter motor is mounted on the flywheel housing on the right-hand side of the engine unit and operates on the flywheel through a conventional worm and pinion.

The headlamps employ the double-filament dipping system. Both lamps are fitted with double-filament bulbs, both dipping either vertically or to the left or right according to the regulations existing in the countries concerned.

Section N.1

BATTERY MAINTENANCE

The battery is a 12-volt lead-acid type, having six cells, each cell consisting of a group of positive and negative plates immersed in a solution of sulphuric acid and distilled water (electrolyte).

The battery has three functions: to supply current for starting, ignition, and lighting; to provide a constant supply of current to the electrical equipment under normal operating conditions and when the consumption of the electrical equipment exceeds the output of the generator; to control the voltage of the electrical supply system.

Adjustments in the vehicle

The purpose of the following operations is to maintain the performance of the battery at its maximum.

The battery and its surrounding parts should be kept dry and clean, particularly the tops of the cells, as any dampness could cause a leakage between the securing strap and the battery negative terminal, resulting in a partially discharged battery. Clean off any corrosion from the battery bolts, strap, and tray with diluted ammonia, afterwards painting the affected parts with anti-sulphuric paint.

Remove the vent plugs and check that they are not perished or cracked, otherwise leakage of electrolyte will occur. Clean out the vent holes if necessary with a piece of wire.

The electrolyte levels should be maintained just above the tops of the separators by adding distilled water. Never add acid.

Check the terminal posts. If they are corroded remove the cables and clean with diluted ammonia. Smear the posts with petroleum jelly before remaking the connections and ensure that the cable terminal screws are secure.

Test the condition of the battery cells by using a hydrometer.

The specific gravity readings and their indications are as follows:

For climates below 27° *C.* (80° *F.*)	
Cell fully charged	1·270 to 1·290
Cell about half-charged	1·190 to 1·210
Cell completely discharged ..	1·110 to 1·130
For climates above 27° *C.* (80° *F.*)	
Cell fully charged	1·210 to 1·230
Cell about half-charged	1·130 to 1·150
Cell completely discharged ..	1·050 to 1·070

These figures are given assuming an electrolyte temperature of 16° C. (60° F.). If the temperature of the electrolyte exceeds this ·002 must be added to hydrometer readings for each 3° C. (5° F.) rise to give the true specific gravity. Similarly, ·002 must be subtracted from hydrometer readings for every 3° C. (5° F.) below 16° C. (60° F.).

The readings of all the cells should be approximately the same. If one cell gives a reading very different from the rest it may be that the electrolyte has been spilled or has leaked from the cell or there may be an internal fault. In this case it is advisable to have the battery examined by a battery specialist. Should a battery be in a low state of charge, it should be recharged by taking the car for a long daytime run or by charging from an external source of D.C. supply at a current rate of 3·0 amps. until the cells are gassing freely.

Removing

Disconnect both cables from the battery.

Release the battery clamp and lift out the battery.

Viewing

Place the battery on a lead-covered bench or on a wooden bench treated with anti-sulphuric paint.

Check the electrolyte levels.

Inspect the container for cracks, which may be indicated by external corrosion or extreme variation in the electrolyte levels. A cracked container must be renewed.

Test the condition of the battery cells by using a hydrometer. All readings should be uniform. The hydrometer values given indicate the state of charge of the battery.

If the electrolyte level is below the tops of the separators it will not be possible to withdraw a sufficient amount to raise the hydrometer float. In such circumstances a high-rate discharge tester should be used.

NOTE.—The use of a discharge tester is not recommended for normal testing, but only where a hydrometer reading cannot be obtained due to an excessively low electrolyte level.

Recharging from an external source

The length of time for a used battery to remain on charge before it can be accepted as fully charged depends

entirely on the specific gravity before charging commences and the charging rate. The charging should continue at 3·0 amps. until all cells are gassing freely and evenly and the specific gravity in each of the six cells has reached a maximum, i.e. has shown no further rise in four hours. The specific gravity at the end of charging should be within the limits given and should not vary ·005 from the values given.

Do not allow the temperature of the electrolyte to exceed the maximum permissible temperature, i.e.

For climates below 27° C. (80° F.) .. 38° C. (100° F.).

For climates above 27° C. (80° F.) .. 49° C. (120° F.).

If this temperature is reached the charge should be suspended to allow the temperature to fall at least 5·5° C. (10° F.), otherwise the life of the battery will tend to be shortened.

Installing

The installation of the battery is a reversal of the procedure **'Removing'**. Smear the terminal posts and cable connections with petroleum jelly and tighten the terminal securing screws sufficiently to prevent the cables from moving on the terminal posts when tested by hand, but do not overtighten.

Section N.2

PREPARING DRY-CHARGED BATTERIES FOR SERVICE

Dry-charged batteries are supplied without electrolyte but with the plates in a charged condition. When they are required for service it is only necessary to fill each cell with sulphuric acid of the correct specific gravity. No initial charging is required. This procedure ensures that there is no deterioration of the efficiency of the battery during the storage period before the battery is required for use.

In these batteries micro-porous rubber separators are used between the plates.

Preparing electrolyte

The electrolyte is prepared by mixing together distilled water and concentrated sulphuric acid, taking the precautions given in Section N.3. The specific gravity of the filling electrolyte depends on the climate in which the battery is to be used.

The total volume of electrolyte required to fill a two-volt dry-charged cell is ½ pint (·28 litre).

Filling the battery

Carefully break the seals in the cell filling holes and fill each cell with electrolyte to the top of the separators, **in one operation.** The temperature of the filling room, battery, and electrolyte should be maintained between 16 and 38° C. (60 and 100° F.). If the battery has been stored in a cool place it should be allowed to warm up to room temperature before filling.

Putting into use

Batteries filled in this way are capable of giving a starting discharge **one hour after filling.** When time permits, however, a short freshening charge at the normal recharge rate (3·0 amps.) will ensure that the battery is fully charged.

During the charge the electrolyte must be kept level with the top edge of the separators by addition of distilled water. Check the specific gravity of the acid at the end of the charge; if 1·260 acid was used to fill the battery, the specific gravity should now be between 1·270 and 1·290. If 1·210 acid was used the specific gravity should now be between 1·210 and 1·230. After filling, a dry-charged battery needs only the attention normally given to a lead-acid battery.

Section N.3

PREPARING NEW, UNFILLED, UNCHARGED BATTERIES FOR SERVICE

Preparing electrolyte

Batteries should not be filled with acid until required for initial charging. Electrolyte is prepared by mixing distilled water and concentrated sulphuric acid, usually of 1·840 S.G. The mixing must be carried out either in a lead-lined tank or in suitable glass or earthenware vessels. Slowly add the acid to the water, stirring with a glass rod. **Never add the water to the acid,** as the resulting chemical reaction causes violent and dangerous spurting of the concentrated acid. The approximate proportions of acid and water are indicated in the following table:

For climates	*To obtain specific gravity (corrected to 16° C. [60° F.]) of*	*Add 1 vol. of acid to 1·840 S.G. (corrected to 16° C. [60° F.]) to*
Below 27° C. (80° F.)	1·260	3·2 volumes of water
Above 27° C. (80° F.)	1·210	4·3 volumes of water

Heat is produced by mixing acid and water, and the electrolyte should be allowed to cool before taking hydrometer readings—unless a thermometer is used to measure the actual temperature and a correction applied to the readings before pouring the electrolyte into the battery.

The total volume of electrolyte required to fill a two-volt cell is ½ pint (·28 litre).

Filling the battery

The temperature of the acid, battery, and filling room must not be below 0° C. (32° F.).

Carefully break the seals in the filling holes and **half-fill** each cell with electrolyte of the appropriate specific gravity. Allow the battery to stand for at least six hours in order to dissipate the heat generated by the chemical action of the acid on the plates and separators, and then add sufficient electrolyte to fill each cell to the top of the separators. Allow to stand for a further two hours and then proceed with the initial charge.

Initial charge

The initial charging rate is 2·0 amperes. Charge at this rate until the voltage and specific gravity readings show no increase over five successive hourly readings. This will take from 48 to 80 hours, depending on the length of time the battery has been stored before charging.

Keep the current constant by varying the series resistance of the circuit or the generator output. **This charge should not be broken by long rest periods.** If, however, the temperature of any cell rises above the permissible maximum, i.e.

For climates below 27° C. (80° F.) .. 38° C. (100° F.).
For climates above 27° C. (80° F.) .. 49° C. (120° F.).

the charge must be interrupted until the temperature has fallen at least 5·5° C. (10° F.) below that figure. Throughout the charge the electrolyte must be kept level with the top of the separators by addition of acid solution of the same specific gravity as the original filling-in acid until specific gravity and charge readings have remained constant for five successive hourly readings. If the charge is continued beyond that point, top up with distilled water.

At the end of the charge carefully check the specific gravity in each cell to ensure that, when corrected to 16° C. (60° F.) it lies between the specified limits. If any cell requires adjustment some of the electrolyte must be siphoned off and replaced either by distilled water or by acid of strength originally used for filling in, depending on whether the specific gravity is too high or too low. Continue the charge for an hour or so to ensure adequate mixing of the electrolyte and again check the specific gravity readings. If necessary, repeat the adjustment process until the desired reading is obtained in each cell. Finally, allow the battery to cool, and siphon off any surplus electrolyte.

Section N.4

DYNAMO

Testing on vehicle when dynamo is not charging

(1) Make sure that belt slip is not the cause of the trouble. It should be possible to deflect the belt approximately ½ in. (13 mm.) at the centre of its longest run between two pulleys with moderate hand pressure. If the belt is too slack, tightening is effected by slackening the two dynamo suspension bolts and then the bolt of the slotted adjustment link. A gentle pull on the dynamo outwards will enable the correct tension to be applied to the belt and all three bolts should then be tightened firmly.

(2) Check that the dynamo and control box are connected correctly. The dynamo terminal 'D' should be connected to the control box terminal 'D' and the dynamo terminal 'F' connected to the control box terminal 'F'.

(3) After switching off all lights and accessories disconnect the cables from the dynamo terminals marked 'D' and 'F' respectively.

(4) Connect the two terminals with a short length of wire.

(5) Start the engine and set to run at normal idling speed.

(6) Clip the negative lead of a moving-coil-type voltmeter, calibrated 0–20 volts, to one dynamo terminal and the other lead to a good earthing point on the dynamo yoke.

(7) Gradually increase the engine speed, when the voltmeter reading should rise rapidly and without fluctuation. Do not allow the voltmeter reading to reach 20 volts. Do not race the engine in an attempt to increase the voltage. It is sufficient to run the dynamo up to a speed of 1,000 r.p.m.

If there is no reading check the brush gear.

If the reading is low (approximately 1 volt) the field winding may be faulty.

If the reading is approximately 5 volts the armature winding may be faulty.

If the dynamo is in good order leave the temporary link in position between the terminals and restore the original connections, taking care to connect the dynamo terminal 'D' to the control box terminal 'D' and the dynamo terminal 'F' to the control box terminal 'F'. Remove the lead from the 'D' terminal on the control box and connect the voltmeter between this cable and a good earthing point on the vehicle. Run the engine as before. The reading should be the same as that measured directly on the dynamo. No reading on the voltmeter indicates a break in the cable to the dynamo. Carry out the same procedure for the 'F' terminal, connecting the voltmeter between cable and earth. Finally, remove the link from the dynamo. If the reading is correct test the control box (Section N.6).

Removing and replacing

To remove the dynamo disconnect the dynamo leads from the dynamo terminals.

Slacken all four attachment bolts and pivot the dynamo towards the cylinder block to enable the fan belt to be removed from the dynamo pulley. The dynamo can then be removed by withdrawing the two upper and one lower attachment bolts.

Replacement of the dynamo is an exact reversal of this procedure. The two upper fixing bolts must be fitted with a flat washer under the head of each to register against the dynamo attachment points.

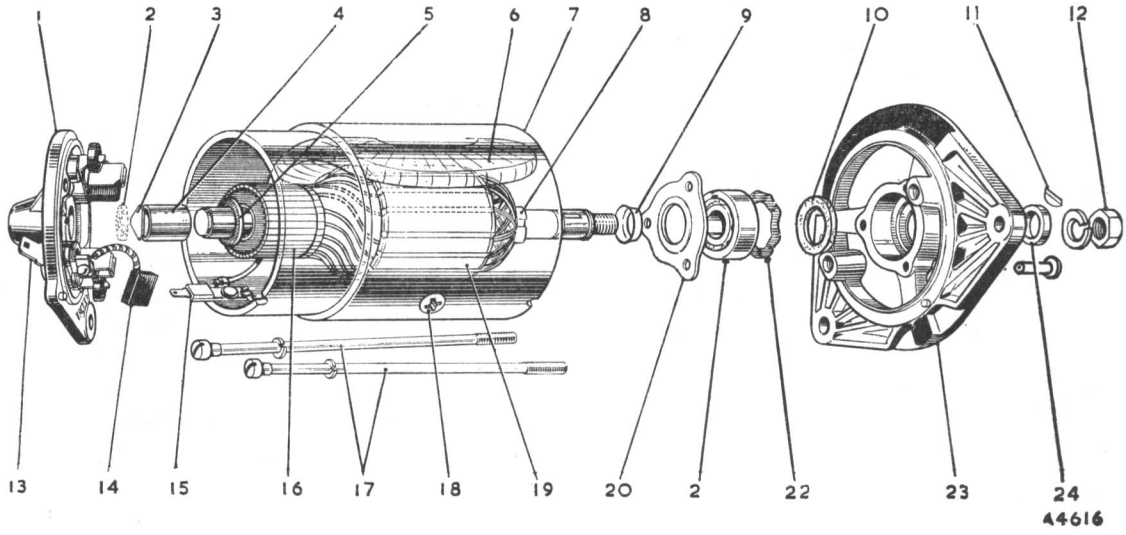

Fig. N.1
The C40/1 type dynamo

1. Commutator end bracket.
2. Felt ring.
3. Felt ring retainer.
4. Bronze bush.
5. Thrust washer.
6. Field coils.
7. Yoke.
8. Shaft collar.
9. Shaft collar retaining cup.
10. Felt ring.
11. Shaft key.
12. Shaft nut.
13. Output terminal 'D'.
14. Brushes.
15. Field terminal 'F'.
16. Commutator.
17. Through-bolts.
18. Pole-shoe securing screws.
19. Armature.
20. Bearing retaining plate.
21. Ball bearing.
22. Corrugated washer.
23. Driving end bracket.
24. Pulley spacer.

Dismantling

Remove the securing nut and take off the drive pulley.

Remove the Woodruff key from the commutator shaft.

Unscrew and remove the two through-bolts and take off the commutator end bracket. The driving end bracket, together with the armature and its ball bearing, can now be lifted out of the yoke. Unless the ball bearing is damaged or requires attention it need not be removed from the armature. Should it be necessary to remove the bearing, the armature must be separated from the end bracket by means of a hand press.

Servicing

Brushes

Test if the brushes are sticking. Clean them with petrol and, if necessary, ease the sides by lightly polishing with a smooth file. Replace the brushes in their original positions.

Test the brush spring tension; the correct tension is between 18 and 26 oz. (510 and 737 gm.). Fit new springs if the tension is below limits.

If the brushes are worn to a minimum length of $\frac{1}{4}$ in. (6·35 mm.) new brushes must be fitted and bedded to the commutator.

Commutator

A commutator in good condition will be smooth and free from pits or burned spots. Clean the commutator with a fuel-moistened cloth. If this is ineffective carefully polish with a strip of fine glass-paper while rotating the armature. To remedy a badly worn commutator mount the armature (with or without the drive end bracket) in a lathe, rotate at high speed, and take a light cut with a very sharp tool. Do not remove more metal than is necessary. Polish the commutator with very fine glass-paper. Undercut the mica insulation between the segments to a depth of $\frac{1}{32}$ in. (·8 mm.) with a hacksaw blade ground down to the thickness of the mica.

Later-type commutators are of the moulded type and may be reskimmed to a minimum diameter of 1·450 in. (36·8 mm.). The undercut must conform to the following dimensions:

Width	..	·040 in. (1·02 mm.).
Depth	..	·020 to ·035 in. (·51 to ·89 mm.).

It is important that the insulating material is cleared from the sides of the undercut to a minimum depth of ·015 in. (·381 mm.).

Field coils

Test the field coils, without removing them from the dynamo yoke, by means of an ohmmeter. The reading on the ohmmeter should be between 6·0 and 6·3 ohms. If this is not available connect a 12-volt D.C. supply with an ammeter in series between the field terminal and the dynamo yoke. The ammeter reading should be approximately 2 amps. If no reading is indicated the field coils are open-circuited and must be renewed. To test for earthed field coils unsolder the end of the field winding from the earth terminal on the dynamo yoke and, with a test lamp connected from supply mains, test across the field terminal and earth. If the lamp lights, the field coils are earthed and must be renewed.

When fitting field coils carry out the procedure outlined below, using an expander and wheel-operated screwdriver:

(1) Remove the insulation piece which is provided to prevent the junction of the field coils from connecting the yoke.
(2) Mark the yoke and pole-shoes in order that they can be refitted in their original positions.

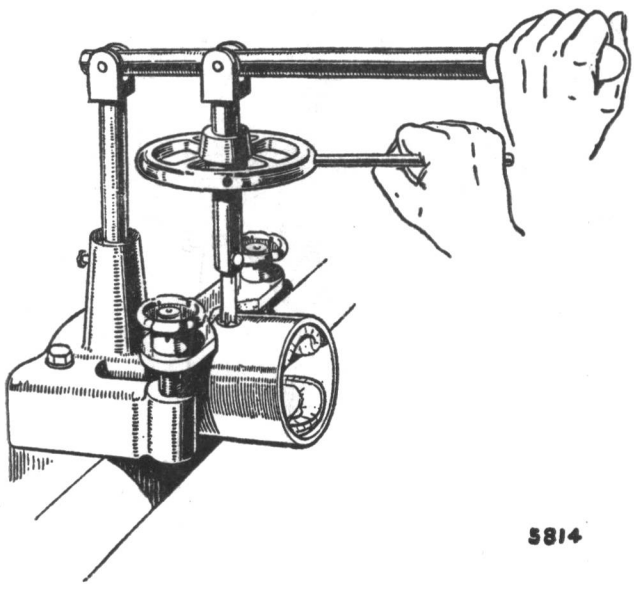

Fig. N.2

Using a wheel-operated screwdriver to remove the pole-shoe screws

(3) Unscrew the two pole-shoe retaining screws by means of the wheel-operated screwdriver.
(4) Draw the pole-shoes and coils out of the dynamo yoke and lift off the coils.
(5) Fit the new field coils over the pole-shoes and place them in position inside the yoke. Take care to ensure that the taping of the field coils is not trapped between the pole-shoes and the yoke.
(6) Locate the pole-shoes and field coils by lightly tightening the fixing screws.
(7) Insert the pole-shoe expander, open it to the fullest extent, and tighten the screws.
(8) Finally, tighten the screws by means of the wheel-operated screwdriver and lock them by caulking.
(9) Replace the insulation piece between the field coil connections and the yoke.

Armature

The testing of the armature winding requires the use of a voltage drop-test and growler. If these are not available the armature should be checked by substitution. No attempt should be made to machine the armature core or to true a distorted armature shaft.

Bearings

Bearings which are worn to such an extent that they will allow side-movement of the armature shaft must be replaced by new ones.

To fit a new bearing at the commutator end of the dynamo proceed as follows:

(1) Screw a $\frac{5}{8}$ in. tap squarely into the old bush and remove the bush.
(2) Press the new bearing bush into the end bracket, using a shouldered mandrel of the same diameter as the shaft which is to fit in the bearing.

Before fitting the new bearing bush allow it to stand completely immersed in thin engine oil for 24 hours to fill the pores of the bush with lubricant.

The ball bearing at the driving end is renewed as follows:

(1) Knock out the rivets which secure the bearing retaining plate to the end bracket and remove the plate.
(2) Press the bearing out of the end bracket and remove the corrugated washer and felt washer.
(3) Before fitting the replacement bearing see that it is clean and pack it with a high-melting-point grease.
(4) Place the felt washer and corrugated washer in the bearing housing in the end bracket.
(5) Locate the bearing in the housing and press it home by means of a hand press.
(6) Fit the bearing retaining plate. Insert the new rivets from the outside of the end bracket and open the rivets by means of a punch to secure the plate rigidly in position.

Reassembling

The reassembly of the dynamo is a reversal of the dismantling sequence.

If the end bracket has been removed from the armature in dismantling, press the bearing end bracket onto the armature shaft, taking care to avoid damaging the end plate and armature winding. When assembling the commutator end bracket the brushes must first be held clear of the commutator by partially withdrawing them from their boxes until each brush is trapped in position by the side pressure of its spring. The brushes can be released onto the commutator by a small screwdriver or similar tool when the end bracket is assembled to within about $\frac{1}{2}$ in. (12·7 mm.) of the yoke. Before closing the gap between the end bracket and the yoke see that the spring are in correct contact with the brushes.

Add a few drops of oil through the hole in the armature end cover.

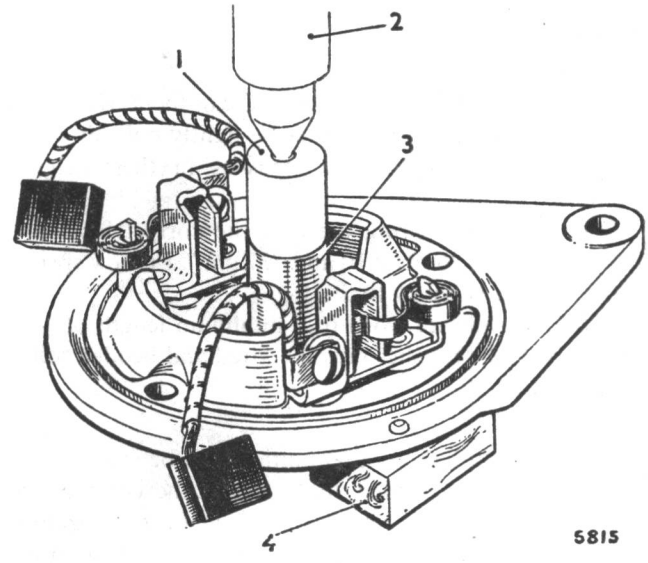

Fig. N.3

The method of pressing in the commutator end bracket bush

1. Shouldered mandrel.
2. Hand press.
3. Bearing bush.
4. Support block.

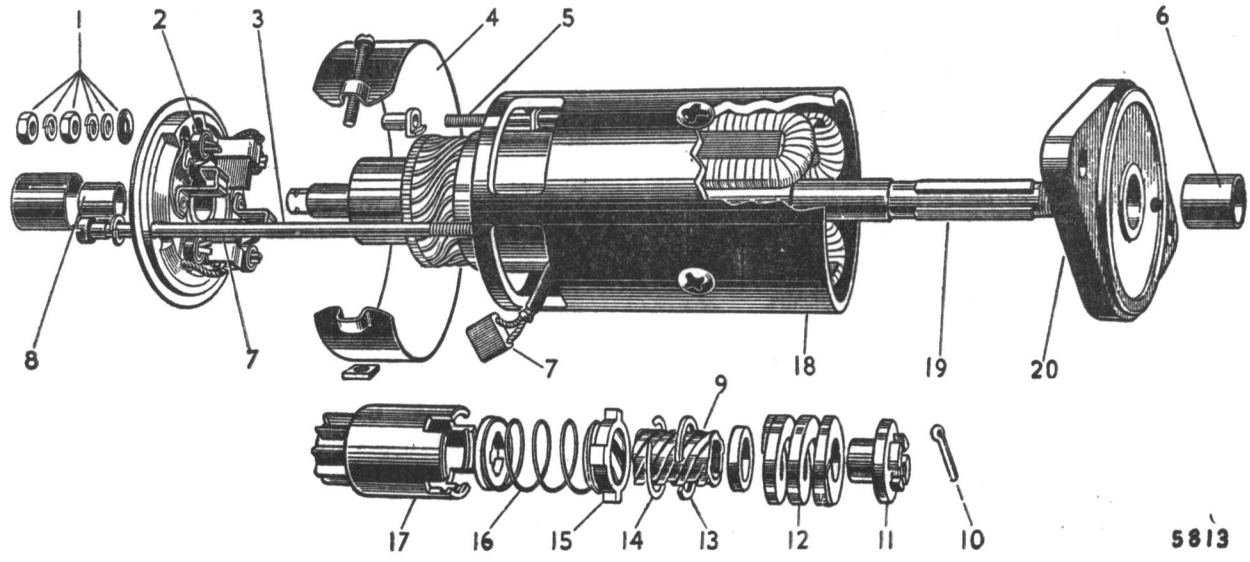

Fig. N.4

An exploded view of the starter motor and drive

1. Terminal nuts and washers.
2. Brush spring.
3. Through-bolt.
4. Band cover.
5. Terminal post.
6. Bearing bush.
7. Brushes.
8. Bearing bush.
9. Sleeve.
10. Split pin.
11. Shaft nut.
12. Main spring.
13. Retaining ring.
14. Washer.
15. Control nut.
16. Restraining spring.
17. Pinion and barrel.
18. Yoke.
19. Armature shaft.
20. Driving end bracket.

Section N.5

STARTER

Testing on vehicle

Switch on the lamps and operate the starter control. If the lights go dim, but the starter is not heard to operate, an indication is given that current is flowing through the starter windings but that the starter pinion is meshed permanently with the geared ring on the flywheel. This was probably caused by the starter being operated while the engine was still running. In this case the starter must be removed from the engine for examination.

Should the lamps retain their full brilliance when the starter switch is operated, check that the switch is functioning. If the switch is in order examine the connections at the battery, starter switch, and starter, and also check the wiring between these units. Continued failure of the starter to operate indicates an internal fault, and the starter must be removed from the engine for examination.

Sluggish action of the starter is usually caused by a poor connection in the wiring which produces a high resistance in the starter circuit. Check as described above.

Damage to the starter drive is indicated if the starter is heard to operate but does not crank the engine.

Removing and refitting

Release the starter cable from the terminal and unscrew the two starter securing bolts. Manœuvre the starter towards the radiator and lift it clear of the engine.

Refitting is a reversal of this procedure.

Examining commutator and brush gear

Remove the starter cover band (4) (Fig. N.4) and examine the brushes (7) (Fig. N.4) and the commutator. Hold back each of the brush springs (2) (Fig. N.4) and move the brush by pulling gently on its flexible connector. If the movement is sluggish remove the brush from its holder and ease the sides by lightly polishing with a smooth file. Always replace brushes in their original positions. If the brushes are worn so that they no longer bear on the commutator, or if the brush flexible lead has become exposed on the running face, they must be renewed.

If the commutator is blackened or dirty clean it by holding a fuel-moistened cloth against it while the armature is rotated.

Secure the body of the starter in a vice and test by connecting it with heavy-gauge cables to a battery of the correct voltage. One cable must be connected to the starter terminal and the other held against the starter body or end bracket. Under these light-load conditions the starter should run at a very high speed.

If the operation of the starter is still unsatisfactory the starter should be dismantled for detailed inspection and testing.

Dismantling

Take off the cover band (4) (Fig. N.4) at the commutator end, hold back the brush springs (2) (Fig. N.4), and take out the brushes (7) (Fig. N.4) from their holders.

Remove the armature complete with drive from the commutator end bracket and starter frame.

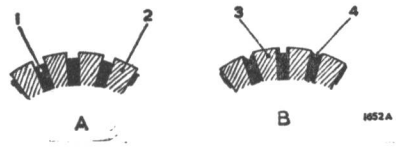

Fig. N.5

The correct method of undercutting the commutator segments (dynamo only)

(A) *Right way*
1. Insulator.
2. Segments.

(B) *Wrong way*
3. Segments.
4. Insulator.

Remove the terminal nuts and washers (1) from the terminal post (5) at the commutator end bracket and also withdraw the two through-bolts. Remove the commutator end bracket and the attachment bracket from the starter frame.

Servicing

Brushes

(1) Test the brush springs with a spring scale. The correct tension is 30 to 40 oz. (850 to 1134 gm.). Fit a new spring if the tension is low.

(2) If the brushes are worn so that they no longer bear on the commutator, or if the flexible connector has become exposed on the running face, they must be renewed. Two of the brushes are connected to terminal eyelets attached to the brush boxes on the commutator end bracket. The other two brushes (7) (Fig. N.4) are connected to tappings on the field coils.

The flexible connectors must be removed by unsoldering and the connectors of the new brushes secured in place by soldering. The brushes are preformed, so that bedding of the working face to the commutator is unnecessary.

Drive

If the pinion is tight on the sleeve wash in paraffin; renew any worn or damaged parts.

To dismantle the drive extract the split pin and remove the shaft nut (11) (Fig. N.4); withdraw the main spring and collar. On later types compress the spring and remove the circlip.

Rotate the barrel to push out the sleeve; remove the barrel and pinion.

The barrel and pinion are supplied as an assembly but the parts may be separated by extracting the retaining ring (13). On later types the assembly is sealed and cannot be dismantled. Renewal must be as an assembly only.

NOTE.—Should either the control nut or screwed sleeve be damaged, a replacement assembly, consisting of a screwed sleeve and control nut, must be fitted. These components must not be fitted individually.

Commutator

A commutator in good condition will be smooth and free from pits and burned spots. Clean the commutator with a cloth moistened with fuel. If this is ineffective carefully polish with a strip of fine glass-paper while rotating the armature. To remedy a badly worn commutator dismantle the starter drive as described above and remove the armature from the end bracket. Now mount the armature in a lathe, rotate it at a high speed, and take a light cut with a very sharp tool. Do not remove any more metal than is absolutely necessary, and finally polish with a very fine glass-paper.

The mica on the **starter** commutator **must not be undercut.**

Field coils

The field coils can be tested for an open circuit by connecting a 12-volt battery, having a 12-volt bulb in one of the leads, to the tapping point of the field coils to which the brushes are connected and the field terminal post. If the lamp does not light there is an open circuit in the wiring of the field coils.

Lighting of the lamp does not necessarily mean that the field coils are in order, as it is possible that one of them may be earthed to a pole-shoe or to the yoke. This may be checked by removing the lead from the brush connector and holding it on a clean part of the starter yoke. Should the bulb now light, it indicates that the field coils are earthed.

Should the above tests indicate that the fault lies in the field coils, they must be renewed. When renewing field coils carry out the procedure detailed in the dynamo Section N.4.

Armature

Examination of the armature will in many cases reveal the cause of failure, e.g. conductors lifted from the commutator due to the starter being engaged while the engine is running and causing the armature to be rotated at an excessive speed. A damaged armature must in all cases be renewed—no attempt should be made to machine the armature core or to true a distorted armature shaft.

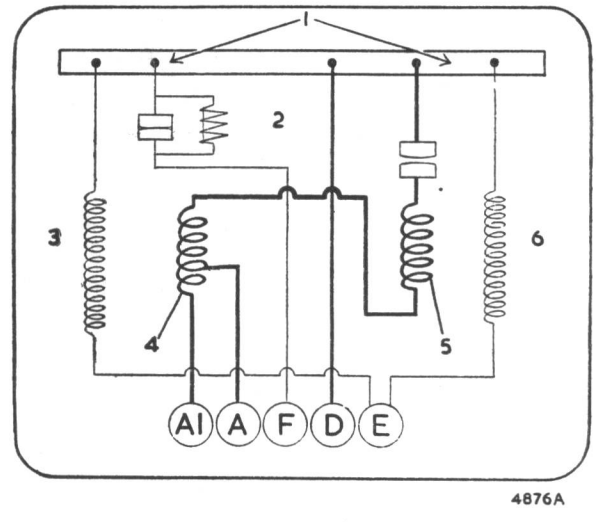

Fig. N.6

The control box (regulator and cut-out) internal connections

1. Regulator and cut-out frame.
2. Field resistance.
3. Shunt coil.
4. Tapped series coil.
5. Series coil.
6. Shunt coil.

Bearings (commutator end)

Bearings which are worn to such an extent that they will allow excessive side-play of the armature shaft must be renewed. To renew the bearing bush proceed as follows.

Press the new bearing bush into the end bracket, using a shouldered mandrel of the same diameter as the shaft which is to fit the bearing.

The bearing bush is of the porous phosphor-bronze type, and before fitting, **new bushes should be allowed to stand completely immersed for 24 hours in thin engine oil in order to fill the pores of the bush with lubricant.**

Reassembling

The reassembly of the starter is a reversal of the operations described in this section.

Section N.6

CONTROL BOX

Description

The control box contains two units—a voltage regulator and a cut-out. Although combined structurally, the regulator and cut-out are electrically separate (see Fig. N.6).

Both are accurately adjusted during manufacture, and the cover protecting them should not be removed unnecessarily.

Regulator

The regulator is set to maintain the dynamo output between close limits at all speeds above the regulating point, the field strength being controlled by the automatic insertion and withdrawl of a resistance in the dynamo field circuit. When the dynamo output reaches a predetermined value the magnetic flux in the regulator core, induced by the shunt or voltage winding, becomes sufficiently strong to attract the armature to the core. This causes the contacts to open, thereby inserting the resistance in the dynamo field circuit.

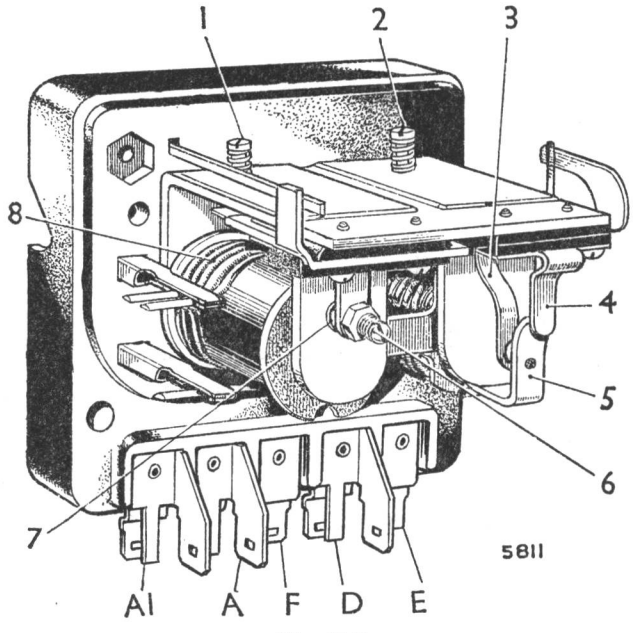

Fig. N.7

The control box

1. Regulator adjusting screw.
2. Cut-out adjusting screw.
3. Fixed contact blade.
4. Stop arm.
5. Armature tongue and moving contact.
6. Regulator fixed contact screw.
7. Regulator moving contact.
8. Regulator series windings.

The consequent reduction in the dynamo field current lowers the dynamo output, and this in turn weakens the magnetic flux in the regulator core. The armature therefore returns to its original position, and with the contacts closed the dynamo output rises again to its regulated maximum. This cycle is then repeated, and an oscillation of the armature is maintained.

As the speed of the dynamo rises above that at which the regulator comes into operation the periods of contact separation increase in length, and as a result the mean value of the dynamo output undergoes practically no increase once this regulating speed has been attained.

The series or current winding provides a compensation on this system of control, for if the control were arranged entirely on the basis of voltage there would be a risk of seriously overloading the dynamo when the battery was in a low state of charge, particularly if the lamps were in use simultaneously.

Under these conditions, with a battery of low internal resistance the dynamo output rises and, but for the series winding, would exceed its normal rating. The magnetism due to the series winding assists the shunt winding, so that when the dynamo is delivering a heavy current into a discharged battery the regulator comes into operation at a somewhat reduced voltage, thus limiting the output accordingly. As shown in Fig. N.6, a split series winding is used, terminal 'A' being connected to the battery and terminal 'A1' to the lighting and ignition switch.

By means of a temperature compensation device the voltage characteristic of the dynamo is caused to conform more closely to that of the battery under all climatic conditions. In cold weather the voltage required to charge the battery at a given rate increases, whilst in warm weather the voltage required is lower. The compensation device is in the form of a bi-metal spring located behind the tensioning spring of the regulator armature. By causing the operating voltage of the regulator to be increased in cold weather and reduced in hot weather the bi-metal spring compensates for the changing temperature characteristics of the battery and prevents undue variation of the charging current which would otherwise occur. The bi-metal spring also compensates for effects due to increases in resistance of the copper windings from cold to working values.

Cut-out

The cut-out is an electro-magnetically operated switch connected in the charging circuit between the dynamo and the battery. It automatically connects the dynamo with the battery when the dynamo output exceeds that of the battery and disconnects the two when the dynamo output falls below that of the battery, and so prevents the battery from discharging and possibly damaging the dynamo windings.

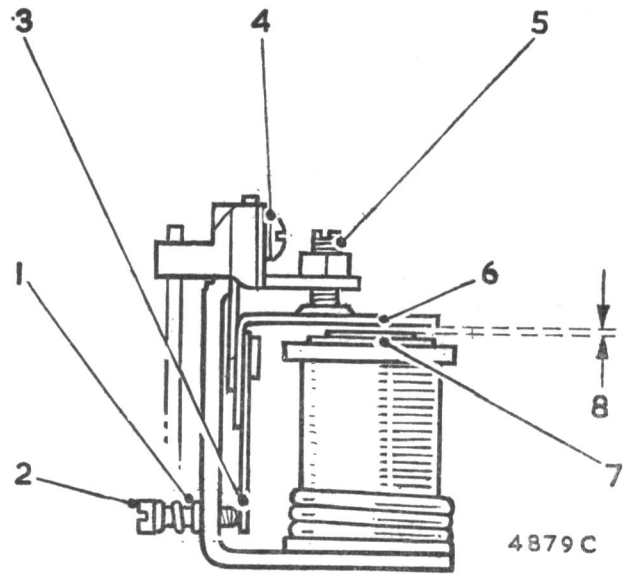

Fig. N.8

Mechanical setting of the regulator

1. Locknut.
2. Voltage adjusting screw.
3. Armature tension spring.
4. Armature securing screws.
5. Fixed contact adjustment screw.
6. Armature.
7. Core face and shim.
8. ·021 in. (·533 mm.).

The cut-out consists of an electro-magnet fitted with an armature which operates a pair of contacts. The electro-magnet employs two windings—a shunt winding of many turns of fine wire and a series winding of a few turns of heavier-gauge wire. The contacts are normally held open and are closed only when the magnetic pull from the armature is sufficient to overcome the tension of the adjusting spring.

The shunt coil is connected across the dynamo. When starting, the speed of the engine and thus the output of the dynamo rises until the electro-magnet is strong enough to overcome the spring tension and close the cut-out contacts. The effect of the charging current flowing through the cut-out windings creates a magnetic field in the same direction as that produced by the shunt winding. This increases the magnetic pull on the armature so that the contacts are firmly closed and cannot be separated by vibration. When the speed of the dynamo falls to a point where its output is lower than that of the battery, current flows from the battery through the cut-out series winding and dynamo in a reverse direction to the charging current. This reverse current through the cut-out will produce a differential action between the two windings and partly demagnetize the electro-magnet. The spring, which is under constant tension, then pulls the armature away from the magnet and so separates the contacts and opens the circuit.

Like the regulator, the operation of the cut-out is temperature-controlled by means of a bi-metal tensioning spring.

Regulator adjustment

The regulator is carefully set before leaving the Works to suit the normal requirements of the standard equipment, and in general it should not be necessary to alter it. If, however, the battery does not keep in a charged condition, or if the dynamo output does not fall when the battery is fully charged, it may be advisable to check the setting and, if necessary, to readjust it.

It is important, before altering the regulator setting, when the battery is in a low state of charge, to check that its condition is not due to a battery defect or to the dynamo belt slipping.

Electrical setting (with unit cold)

The electrical setting of the control unit can be checked without removing the cover. Use a good-quality moving-coil voltmeter (0–20 volts).

Withdraw the cables from the control box terminals 'A' and 'A1' and connect these cables together.

Connect the negative lead of the voltmeter to the control box terminal 'D' and connect the other lead to terminal 'E'.

Slowly increase the speed of the engine until the voltmeter needle flicks and then steadies. This should occur at a voltmeter reading between 15·8 and 16·7 volts according to the ambient temperature.

If the voltage at which the reading becomes steady occurs outside these limits the regulator must be adjusted.

Switch off the engine and remove the control box cover.

Turn the voltage adjusting screw (1) (Fig. N.8) in a clockwise direction to raise the setting or in an anti-clockwise direction to lower the setting. Turn the screw only a fraction of a turn at a time. Repeat as above until the correct setting is obtained.

The adjustment of the regulator open-circuit voltage should be completed within 30 seconds, otherwise heating of the shunt winding will cause false setting to be made.

A dynamo run at high speed on open circuit will build up a high voltage. Therefore, when adjusting the regulator increase the engine speed slowly until the regulator operates, otherwise a false setting may be made.

Reconnect the wires.

Mechanical setting

The mechanical or air gap settings of the regulator shown in Fig. N.8 are accurately adjusted before leaving the Works, and, provided that the armature carrying the moving contact is not removed, these settings must not be tampered with. If, however, the armature has been removed the regulator will have to be reset. To do this proceed as follows.

Slacken the fixed contact locking nut and unscrew the contact screw until it is quite clear of the armature moving contact.

Unscrew the voltage adjusting screw until it is well clear of the armature tension spring.

Slacken the two armature assembly securing screws.

Using a ·021 in. (·533 mm.) thick feeler gauge, wide enough to cover completely the core face, insert the

gauge between the armature and the core shim, taking care not to turn up or damage the edge of the shim.

Press the armature **squarely** down against the gauge and retighten the two armature assembly securing screws.

With the gauge still in position, screw the adjustable contact down until it just touches the armature contact. Retighten the locking nut.

Reset the voltage adjusting screw as described under **'Regulator adjustment'.**

Cleaning contacts

After long periods of service it may be found necessary to clean the regulator contacts. Clean the contacts by means of a fine carborundum stone or fine emery-cloth.

Carefully wipe away all traces of dust or other foreign matter with methylated spirits.

Cut-out adjustment

Electrical setting

If the regulator is correctly set but the battery is still not being charged the cut-out may be out of adjustment. To check the voltage at which the cut-out operates remove the control box cover and connect the voltmeter between terminals 'D' and 'E'. Start the engine and slowly increase its speed until the cut-out contacts are seen to close, noting the voltage at which this occurs. It should be 12·7 to 13·3 volts.

If the cut-out operates outside these limits it will be necessary to adjust it to within the limits. To do this turn the cut-out adjusting screw in a clockwise direction to raise the voltage setting or in an anti-clockwise direction to reduce the setting. Turn the screw only a fraction of a turn at a time. Test after each adjustment by increasing the engine speed and noting the voltmeter readings at the instant of contact closure. Electrical settings of the cut-out, like the regulator, must be made as quickly as possible because of the temperature rise effects.

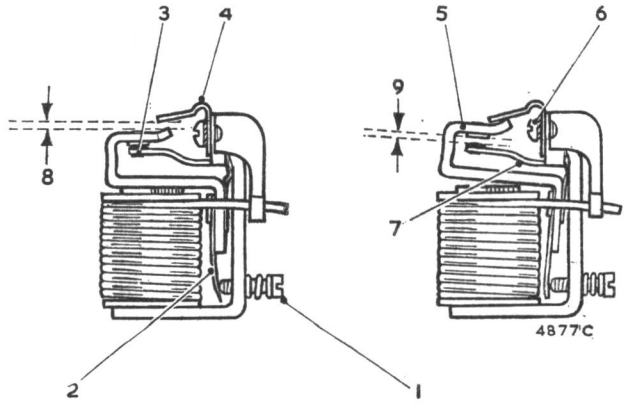

Fig. N.9

Mechanical setting of the cut-out

1. Cut-out adjusting screw.
2. Armature tension spring.
3. 'Follow through'—·010 to ·020 in. (·25 to ·51 mm.).
4. Stop arm.
5. Armature tongue and moving contact.
6. Armature securing screws.
7. Fixed contact blade.
8. ·030 in. (·76 mm.).
9. ·010 to ·020 in. (·25 to ·51 mm.).

If the cut-out does not operate there may be an open circuit in the wiring of the cut-out and regulator unit, in which case the units should be removed for examination or renewal.

Mechanical setting

If for any reason the cut-out armature has to be removed from the frame care must be taken to obtain the correct air gap settings on reassembly. These can be obtained as follows.

Unscrew the cut-out adjusting screw until it is well clear of the armature tension spring.

Slacken the two armature securing screws.

Press the armature **squarely** down against the copper-sprayed core face and retighten the armature securing screws.

Using a pair of thin-nosed pliers, adjust the gap between the armature stop arm and the armature tongue by bending the stop arm. The gap must be ·030 in. (·76 mm.) when the armature is pressed **squarely** down against the core face.

When the armature is in the free position the contacts gap should be ·010 to ·020 in. (·25 to ·51 mm.).

Similarly, the fixed contact blade must be bent so that when the armature is pressed **squarely** down against the core face there is a 'follow through' of blade deflection of ·010 to ·020 in. (·25 to ·51 mm.). See (3) (Fig. N.9).

Reset the cut-out adjusting screw in accordance with the instructions already given.

Cleaning contacts

Do not use emery-cloth or a carborundum stone for cleaning cut-out contacts. If the contacts appear dirty, rough, or burnt place a strip of fine glass-paper between the contacts and then, with the contacts closed by hand, draw the paper through. This should be done two or three times with the rough side of the glass-paper towards each contact.

Wipe away all dust or other foreign matter, using a clean, fluffless cloth moistened with methylated spirits.

Section N.7

FUSES

Two 35-amp. fuses are mounted in a separate fusebox and are therefore accessible without removing the control box cover (see Fig. N.10).

Units protected

The units which are protected by each fuse can readily be identified by referring to the wiring diagram on page N.17.

Blown fuses

A blown fuse is indicated by the failure of all the units protected by it, and is confirmed by examination of the fuse, which can easily be withdrawn from the spring clips. If it has blown the fused state of the wire will be

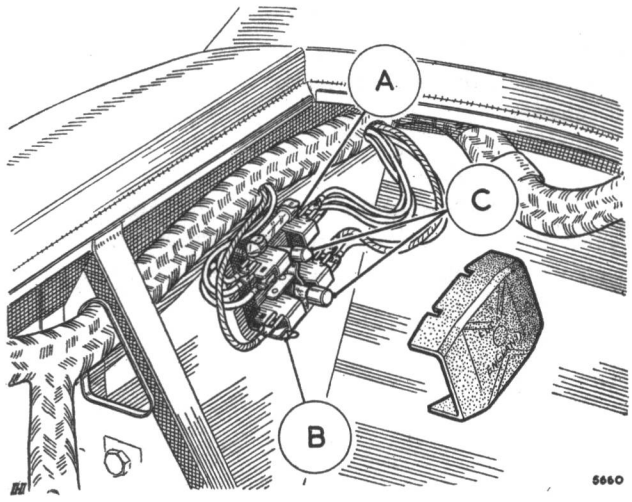

Fig. N.10

The fuse block mounted on the right-hand valance

A. 35-amp. fuse. B. 35-amp. fuse.
C. Spare fuses.

visible inside the glass tube. Before renewing a blown fuse inspect the wiring of the units that have failed for evidence of a short circuit or other faults which may have caused the fuse to blow and remedy the cause of the trouble.

Section N.8

LOCATION AND REMEDY OF FAULTS

Although every precaution is taken to eliminate possible causes of trouble, failure may occasionally develop through lack of attention to the equipment or damage to the wiring. The following pages set out the recommended procedure for a systematic examination to locate and remedy the causes of some of the more usual faults encountered.

The sources of trouble are by no means always obvious, and in some cases a considerable amount of deduction from the symptoms is needed before the cause is disclosed.

For instance, the engine might not respond to the starter switch; a hasty inference would be that the starter motor is at fault. However, as the motor is dependent on the batteries it may be that the batteries are exhausted.

This in turn may be due to the dynamo failing to charge the batteries, and the final cause of the trouble may be, perhaps, a loose connection in some part of the charging circuit.

If, after carrying out an examination, the cause of the trouble is not found the equipment should be checked by the nearest Lucas Service Depot or Agent.

CHARGING CIRCUIT

1. Batteries in low state of charge

(*a*) This state will be shown by lack of power when starting, poor light from the lamps, and the hydrometer readings below 1·200. It may be due to the dynamo not charging or giving low or intermittent output. The ignition warning light will not go out if the dynamo fails to charge, or will flicker on and off in the event of intermittent output.

(*b*) Examine the charging and field circuit wiring, tighten any loose connections, or renew any broken cables. Pay particular attention to the battery connections.

(*c*) Examine the dynamo driving belt; take up any undue slackness by swinging the dynamo outwards on its mounting after slackening the attachment bolts.

(*d*) Check the regulator setting, and adjust if necessary.

2. Batteries overcharged

This will be indicated by burnt-out bulbs, very frequent need for topping up the batteries, and high hydrometer readings. Check the charge reading with an ammeter when the car is running. It should be of the order of only 3 to 4 amps.

If the ammeter reading is in excess of this value it is advisable to check the regulator setting, and adjust if necessary.

STARTER MOTOR

1. Starter motor lacks power or fails to turn engine

(*a*) See if the engine can be turned over by hand. If not, the cause of the stiffness in the engine must be located and remedied.

(*b*) If the engine can be turned by hand first check that the trouble is not due to a discharged battery.

(*c*) Examine the connections to the batteries, starter, and starter switch, making sure that they are tight and that the cables connecting these units are not damaged.

(*d*) It is also possible that the starter pinion may have jammed in mesh with the flywheel, although this is by no means a common occurrence. To disengage the pinion rotate the squared end of the starter shaft by means of a spanner.

2. Starter operates but does not crank the engine

This fault will occur if the pinion of the starter drive is not allowed to move along the screwed sleeve into engagement with the flywheel, due to dirt having collected on the screwed sleeve. Remove the starter and clean the sleeve carefully with paraffin (kerosene).

3. Starter pinion will not disengage from flywheel when engine is running

Stop the engine and see if the starter pinion is jammed in mesh with the flywheel, releasing it if necessary by rotation of the squared end of the starter shaft. If the pinion persists in sticking in mesh have the equipment examined at a Service Depot. Serious damage may result to the starter if it is driven by the flywheel.

LIGHTING CIRCUITS

1. Lamps give insufficient illumination

(*a*) Test the state of charge of the battery, recharging it if necessary from an independent electrical supply.

(*b*) Check the setting of the lamps.

(*c*) If the bulbs are discoloured as the result of long service they should be renewed.

2. Lamps light when switched on but gradually fade out

As paragraph 1 (*a*).

3. Brilliance varies with speed of car

(*a*) As paragraph 1 (*a*).

(*b*) Examine the battery connections, making sure that they are tight, and renew any faulty cables.

Section N.9

WINDSHIELD WIPER

Normally the windshield wiper will not require any servicing apart from the occasional renewal of the rubber blades.

Should any trouble be experienced, first check for loose connections, worn insulation, etc., before dismantling the motor.

To detach the cable rack from the motor and gearbox

Unscrew the pipe union nut.

Remove the gearbox cover.

Remove the retaining washer from the crankpin and final gear wheel.

Lift off the connecting link.

Commutator dirty

Remove the connecting leads to the terminals and withdraw the three screws securing the cover at the commutator end. Lift off the cover. Clean the commutator with a cloth moistened with petrol (gasoline) and carefully remove any carbon dust from between the commutator segments.

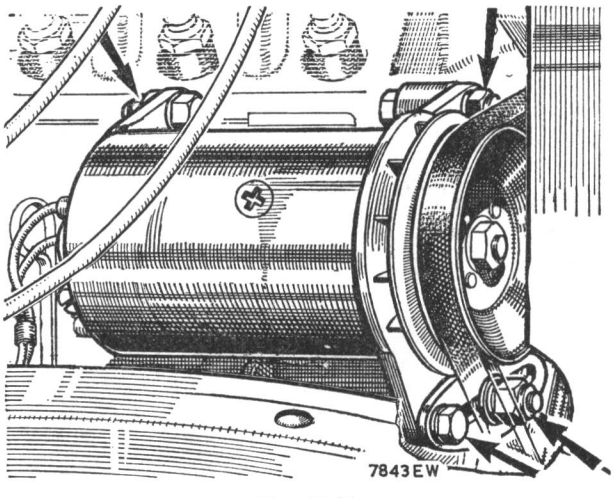

*Fig. N.*11

The four mounting points that must be slackened for fan belt adjustment

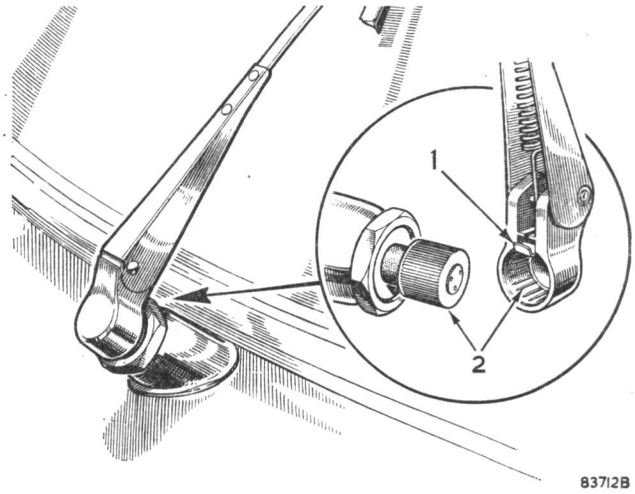

*Fig. N.*12

Removal and replacement of the windshield wiper arm

1. Retaining clip. 2. Splined drive.

Brush lever stiff or brushes not bearing on commutator

Check that the brushes bear freely on the commutator. If they are loose and do not make contact a replacement tension spring is necessary. The brush levers must be free on their pivots. If they are stiff they should be freed by working them backwards and forwards by hand and by applying a trace of thin machine oil. Packing shims are fitted beneath the legs of the brush to ensure that the brushes are central and that there is no possibility of the brush boxes fouling the commutator. If the brushes are considerably worn they must be replaced by new ones.

Motor operates but does not transmit motion to spindles

Remove the cover of the gearbox. A push-pull motion should be transmitted to the inner cable of the flexible rack. If the cross-head moves sluggishly between the guides lightly smear a small amount of medium-grade engine oil in the groove formed in the die-cast housing. When overhauling, the gear must be lubricated by lightly packing the gearbox with a grease to Ref. C (page P.2).

Thrust screw adjustments

The thrust screw is located on the top of the cross-head housing. To adjust, slacken the locknut, screw down the thrust screw until it contacts the armature, and then turn back a fraction of a turn. Hold the thrust screw with a screwdriver and tighten the locknut.

To remove the motor

Detach the cable rack from the motor and gearbox as detailed above. Disconnect the leads. Turn back the body trimming on the left-hand side of the scuttle panel above the parcel tray, and remove the three nuts securing the motor to the panel.

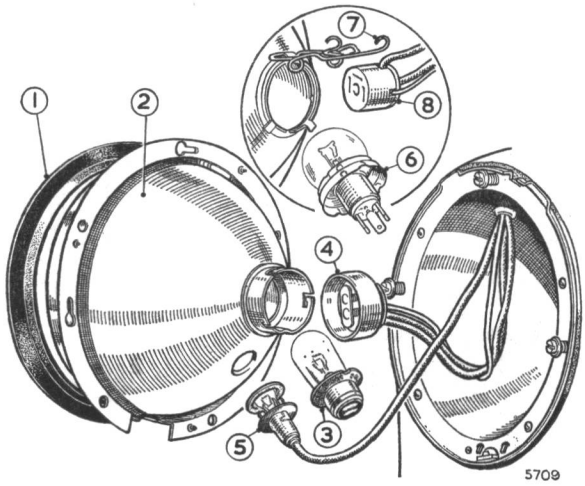

Fig. N.13

The headlamp light unit showing the European type bulb and socket inset

1. Rubber seal.
2. Reflector.
3. Bulb.
4. Back-shell.
5. Pilot lamp.
6. Bulb.
7. Bulb retainer.
8. Socket.

} European type.

Section N.10

HEADLAMPS

The headlamp main bulb is correctly positioned in relation to the reflector, and no focusing is required when a replacement bulb is fitted.

The double-filament bulbs are controlled by a foot-operated dipping switch deflecting both headlamp beams downwards to avoid dazzle.

Certain countries have lighting regulations to which the foregoing arrangements do not conform, and cars exported to such countries have suitably modified lighting equipment.

Removing the light unit

To remove the light unit for bulb replacement unscrew the retaining screw at the bottom of the plated lamp rim and lift the rim away from the dust-excluding rubber.

Remove the dust-excluding rubber, which will reveal the three spring-loaded screws. Press the light unit inwards against the tension of the springs and turn it in an anti-clockwise direction until the heads of the screws can pass through the enlarged ends of the keyhole slots in the lamp rim.

This will enable the light unit to be withdrawn sufficiently to give attention to the wiring and bulbs.

Bulb replacement—R.H.D. and L.H.D. (except European type)

With the light unit withdrawn, twist the back-shell anti-clockwise and pull it off. Withdraw the bulb from the holder.

Insert the replacement bulb in the holder, making sure that the slot in the periphery of the bulb flange engages the projection in the holder.

Engage the projections on the back-shell with the slots of the holder, press it on, and twist it clockwise until it engages with its catch.

Bulb replacement (European type)

The headlamps fitted to left-hand-drive cars for use in European countries are fitted with special front lenses giving an asymmetrical light beam to the right-hand side. Access to the bulb is achieved in the same way as with right-hand-drive cars, but the bulb is released from the reflector by withdrawing the three-pin socket and pinching the two ends of the wire retaining clip to clear the bulb flange. When replacing the bulb make certain that the rectangular pip on the bulb flange engages the slot in the reflector seating.

Replace the spring clip with its coils resting in the base of the bulb flange and engaging the two retaining lugs on the reflector seating.

Refitting the light unit

Position the light unit so that the heads of the adjusting screws coincide with the enlarged ends of the attachment slots. Push the light unit towards the wing to compress the springs and turn the unit to the right as far as it will go, that is, approximately $\frac{1}{2}$ in. (13 mm.).

Replace the dust-excluding rubber on the light rim with its flanged face forward and refit the plated rim.

Beam-setting

The lamps should be set so that the main driving beams are parallel with the road surface or in accordance with local regulations.

If adjustment is required this is achieved by removing the plated rim and dust-excluding rubber. Vertical adjustment can then be made by turning the screw at the top of the lamp in the necessary direction. Horizontal adjustment can be effected by using the adjustment screws on each side of the light unit (see Fig. N.14).

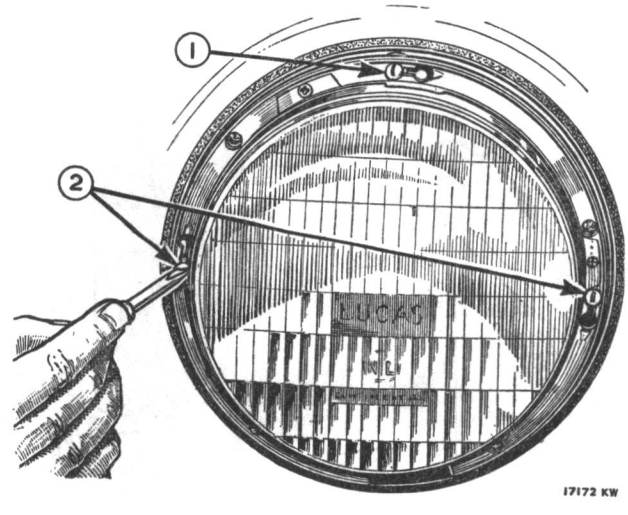

Fig. N.14

The headlamp setting screws

1. Vertical setting adjusting screw.
2. Horizontal setting adjusting screws.

Pilot lamp bulbs

On models where the pilot lamp bulb is incorporated in the headlamp it is accessible when the light unit is removed.

On models where separate pilot lamps are fitted refer to Section N.11 for details of bulb replacement.

Section N.11

PILOT AND FLASHING DIRECTION INDICATOR LAMPS

Access to the bulb for removal and replacement is obtained by folding back the rubber retaining flange and gently prising out the bezel and lens from the lamp body. Use the fingers only to fold back the rubber retaining flange.

To remove the lamp body, extract the three self-tapping screws securing the body to the wing, pull the body forward to separate it from the rubber cover, and release the leads from their connections on the body. When refitting make certain that the spring nuts are positioned over the screw holes in the wing to accept and retain the three self-tapping screws.

Ensure that the lens is seating correctly in the rubber body before refitting the retaining bezel.

Section N.12

FLASHING DIRECTION INDICATORS

The flashing direction indicators are operated by a hand-actuated switch on the steering-column through a flasher unit to the dual-filament bulbs in the pilot lamps and tail lamps. In the event of failure, carry out the following procedure:

(1) Check bulbs for broken filaments.

(2) Refer to the wiring diagram and check over flasher circuit connections.

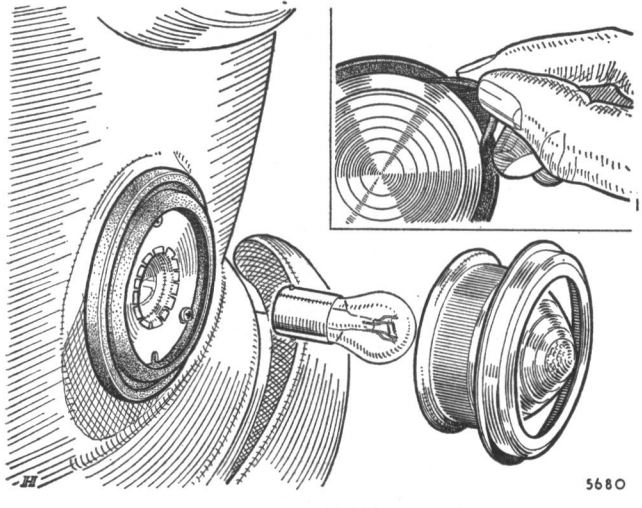

Fig. N.15

The pilot and flashing indicator lamp, showing the method of access to the bulb

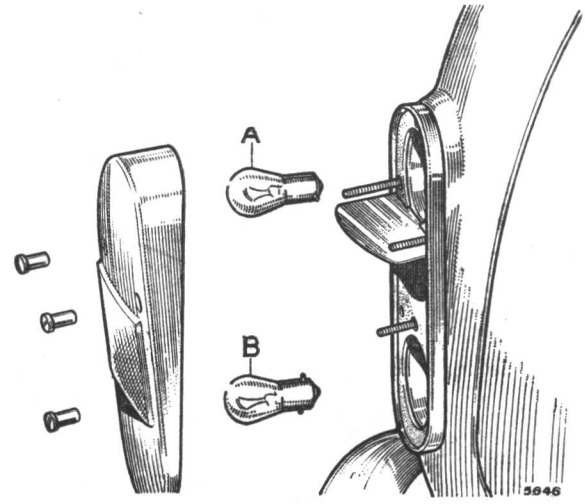

Fig. N.16

The tail lamp, showing the method of access to (A) *the flashing direction indicator bulb and* (B) *the stop/tail lamp bulb*

(3) Switch on the ignition and check that terminal 'B' on the flasher is at 12 volts with respect to earth.

(4) Connect together terminals 'B' and 'L' at the flasher unit and operate the direction indicator switch. If the flasher lamps light up, the flasher unit is at fault and must be renewed. If the lamps do not light a further check of the circuit and the switch must be undertaken.

Maintenance

Flasher units cannot be dismantled for subsequent reassembly. A defective unit must therefore be renewed, care being taken to connect as the original.

Replacement of flasher unit

When replacing a flasher unit or installing a flashing light system it is advisable to test the circuits before connections to flasher terminals are made. When testing join the cables normally connected to those terminals (green, green with brown, and light green) together and operate the direction indicator switch. In the event of a wrong connection having been made, the ignition auxiliaries fuse will blow but no damage will be done to the flasher unit.

Section N.13

TAIL AND STOP AND DIRECTION INDICATOR LAMPS

The tail lamp bulbs are of the double-filament type, the second filament giving a marked increase in brilliance when the brakes are applied.

Access to the bulb is gained by extracting the three female screws from the outer face of the lamp lens to release the lens from the body.

The tail and stop lamp bulb must be fitted one way only; offset retaining pegs ensure that they are replaced correctly.

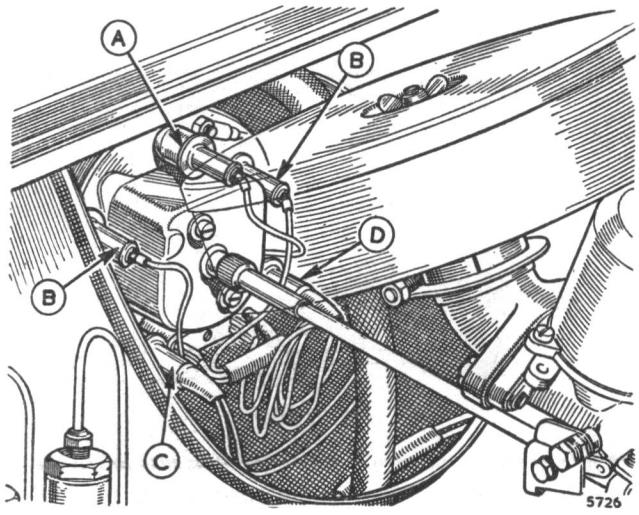

Fig. N.17

The panel and warning lamp bulb holders (Standard, Van, and Pick-up)

A. Headlamp main-beam warning lamp.
B. Instrument illumination lamp.
C. Ignition warning lamp.
D. Oil pressure warning lamp.

The lamp body can be removed when the lens is taken off as indicated in Fig. N.16 and the three screws located in the centre of the body withdrawn. When refitting the glass to the body make certain that it is seating correctly over the sealing rubber.

Section N.14

PANEL AND WARNING LAMPS

Access to the warning lamps for the ignition, headlamp beam, and oil pressure indicators is effected from under the bonnet by withdrawing the push-in-type holders from the rear of the central instrument.

A list of the correct types of bulbs for replacement purposes and their part numbers appears in Section N.16.

Section N.15

NUMBER-PLATE ILLUMINATION LAMP

The number-plate is illuminated by a separate lamp with a miniature bayonet-fitting bulb.

The cover is removed by unscrewing the single attachment screw, which enables it to be withdrawn, giving easy access to the bulb.

Section N.16

REPLACEMENT BULBS

	BMC Part No.	*Volts*	*Watts*
Headlamps (dip left—R.H.D. except Sweden)	BFS 414	12	50/40
Headlamps (dip right—L.H.D. except Europe)	BFS 415	12	50/40
Headlamps (dip vertical—Europe except France)	BFS 410	12	45/40
Headlamps (dip vertical—France)	BFS 411	12	45/40
Headlamps (dip vertical—Sweden)	BFS 370	12	45/40
Pilot lamp	BFS 989	12	6
Pilot lamp and front flashing direction indicator	BFS 380	12	21/6
Flashing direction indicator	BFS 382	12	21
Flashing direction indicator—rear	BFS 382	12	21
Number-plate lamp	BFS 989	12	6
Panel and warning lights	BFS 987	12	2·2
Direction indicator warning light (Lilliput bulb)	BFS 280	12	1·5
Stop/tail lamp	BFS 380	12	21/6
Parcel shelf lamps	BFS 987	12	2·2
Rear companion pocket lamps	BFS 987	12	2·2
Roof lamp	BFS 254	12	6

Section N.17

SEALED-BEAM LIGHT UNITS

A new, improved type of sealed-beam light unit is being fitted to the headlamps of cars exported to U.S.A. and can be identified by the figure '2' moulded into the lens at the two o'clock position. These headlamps must be aimed and set with the beams in the dip position, with the beam setting carried out in accordance with the regulations of the state in which the vehicle is operating.

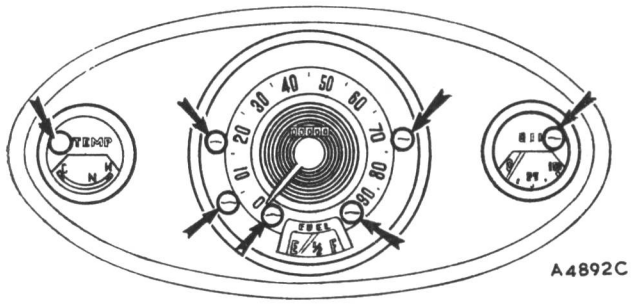

Fig. N.18

The panel and warning lamp bulb holders

Section N.18

PANEL AND WARNING LIGHTS

(Super, Super De-luxe, later Traveller and Countryman)

Access to the warning lights for ignition, headlight beam, and speedometer illumination bulbs is effected from under the bonnet by withdrawing the push-in-type holders from the rear of the speedometer.

To remove the bulbs from the oil and temperature gauges unscrew the four small Phillips screws visible on the instrument panel inside the car and withdraw the panel cover and shroud to expose the gauges. The bulb holders can then be pulled out from the rear of the gauges.

Refitting is a reversal of the removal procedure. Ensure that when the shroud is being refitted the panel light switch is positioned to give a side-to-side action. Should this position of the switch be varied, it could easily result in the switch terminals coming into contact with the oil gauge pipe, thus causing a short circuit in the electrical system.

Section N.19

ROOF LAMP REMOVAL

Squeeze the forward and rear sides of the plastic lens together until the four retaining lugs on the lens are clear of the lamp base and withdraw the lens. Remove the bulb and push out the wires from their terminal sockets. Remove the tubular connectors from the end of the wires, unscrew the screws retaining the lamp base to the roof liner, and detach the lamp.

Section N.20

BI-METAL RESISTANCE INSTRUMENTATION

General description

The bi-metal resistance equipment for fuel and temperature gauges consists of an indicator head and transmitter unit connected to a common voltage stabilizer. In both applications the indicator head operates on a thermal principle, using a bi-metal strip surrounded by a heated winding, and the transmitter unit is of a resistance type. The system by which the equipment functions is voltage-sensitive and the voltage stabilizer, which serves one or more gauges, is necessary to ensure a constant supply of a pre-determined voltage to the equipment.

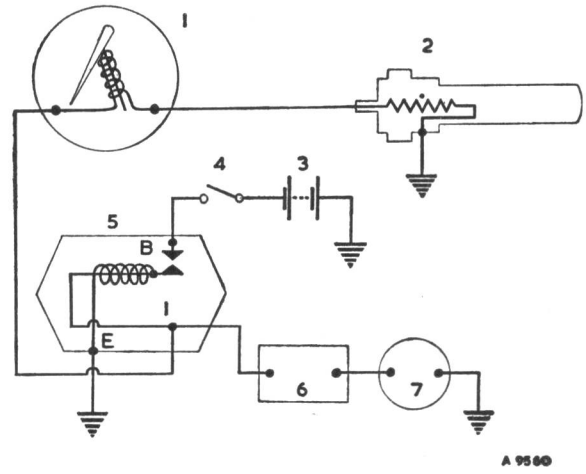

Fig. N.19

The bi-metal resistance instrumentation circuit

1. Temperature gauge.
2. Temperature gauge transmitter.
3. Battery.
4. Ignition switch.
5. Voltage regulator.
6. Fuel gauge.
7. Fuel gauge transmitter.

Fault analysis

Voltage stabilizer

Check the mean voltage between the output terminal 'I' and earth, which should be 10 volts.

Substitute voltage stabilizer if faulty.

Gauges

Check for continuity between terminals with the wiring disconnected. The gauges must not be checked by short circuiting to earth.

Substitute the gauge if faulty.

Transmitter

Check for continuity between terminal and case with lead disconnected.

Substitute transmitter if faulty.

Wiring

Check for continuity between each unit. Check for leak to earth. Check for short circuits to earth on wiring to each transmitter. Check terminal wiring for security, earth connections, and wiring continuity. Check that the voltage stabilizer and relating transmitters are earthed.

NOTE.—If the voltage stabilizer is removed it is essential to ensure that, when replacing, B and E are uppermost and not exceeding 20 degrees from the vertical.

Section N.21

WINDSHIELD WIPER
(Moke)

Removal

(1) Slacken the hexagon screw and pull the blade and arm from the drive spindle.

(2) Remove the nuts, locknuts, washers, and seals securing the motor to the scuttle.

(3) Disconnect the leads from inside the vehicle and withdraw the motor.

NOTE.—A rubber flange with steel inserts is fitted between the wiper motor and the scuttle to prevent the insulating flange being over-compressed.

Refitting

Reverse the removal sequence.

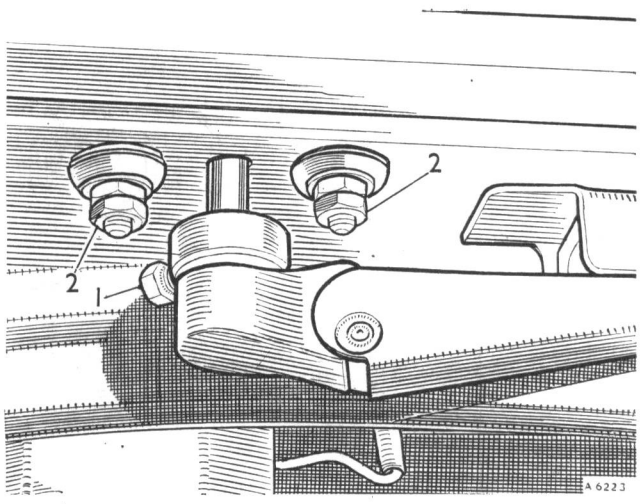

Fig. N.20

The windshield wiper

1. Arm-locating screw. 2. Motor mountings

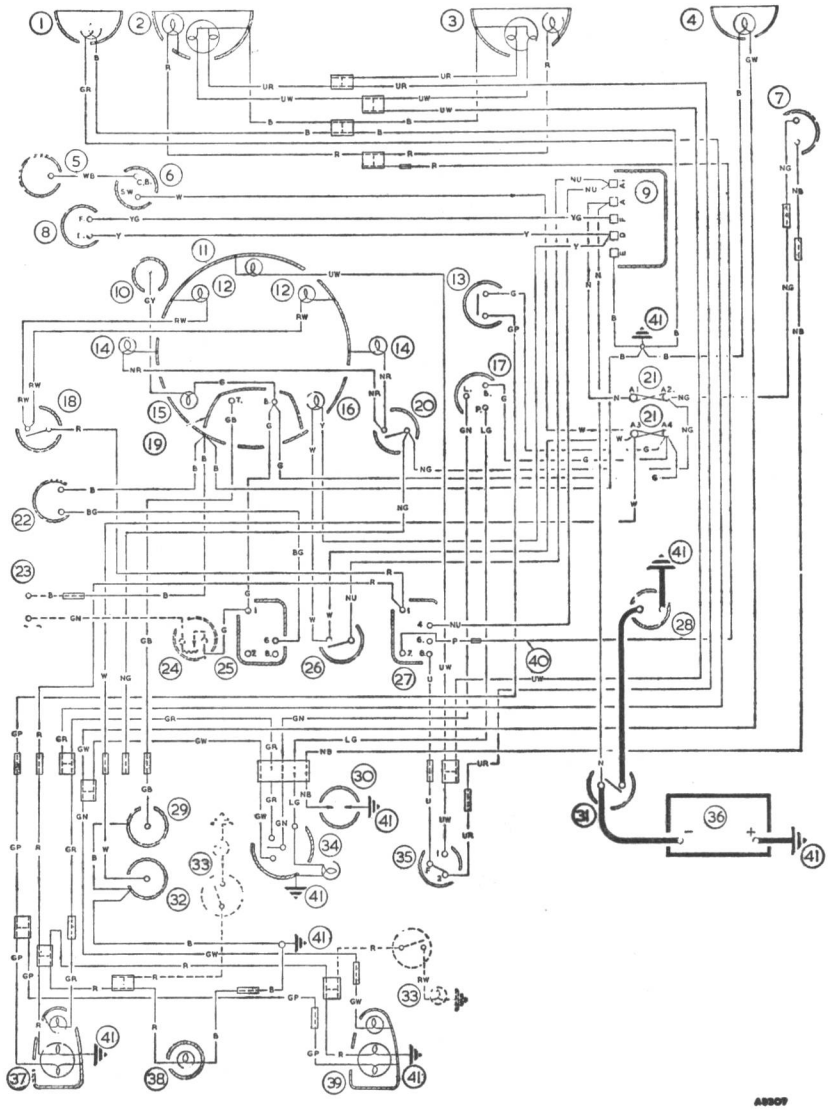

Fig. N.21

Wiring diagram (Standard and De-luxe) up to 1964

1. L.H. flasher lamp.
2. L.H. headlamp and pilot lamp.
3. R.H. headlamp and pilot lamp.
4. R.H. flasher lamp.
5. Distributor.
6. Ignition coil.
7. Horn.
8. Dynamo.
9. Voltage regulator and cut-out.
10. Oil pressure switch.
11. Main-beam warning light.
12. Panel illumination light.
13. Stop light switch.
14. Parcel shelf illumination lamp.
15. Oil pressure warning light.
16. Ignition warning light.
17. Flasher unit.
18. Panel illumination switch.
19. Fuel gauge.
20. Parcel shelf illumination switch.
21. 35-amp. fuse.
22. Wiper motor.
23. Heater motor.
24. Heater switch.
25. Wiper switch.
26. Ignition switch.
27. Lighting switch.
28. Starter motor.
29. Tank unit.
30. Horn-push.
31. Starter switch.
32. Fuel pump.
33. Companion box switch and lamp.
34. Direction indicator switch and warning light.
35. Dipper switch.
36. 12-volt battery.
37. L.H. stop, tail, and flasher lamp.
38. Number-plate illumination lamp.
39. R.H. stop, tail, and flasher lamp.
40. Connect to No. 6 terminal for U.S.A.
41. Earth connection.

CABLE COLOUR CODE

B. Black.	P. Purple.	L. Light.
U. Blue.	R. Red.	D. Dark.
N. Brown.	W. White.	M. Medium.
G. Green.	Y. Yellow.	

When a cable has two colour code letters the first denotes the main colour and the second denotes the tracer colour.

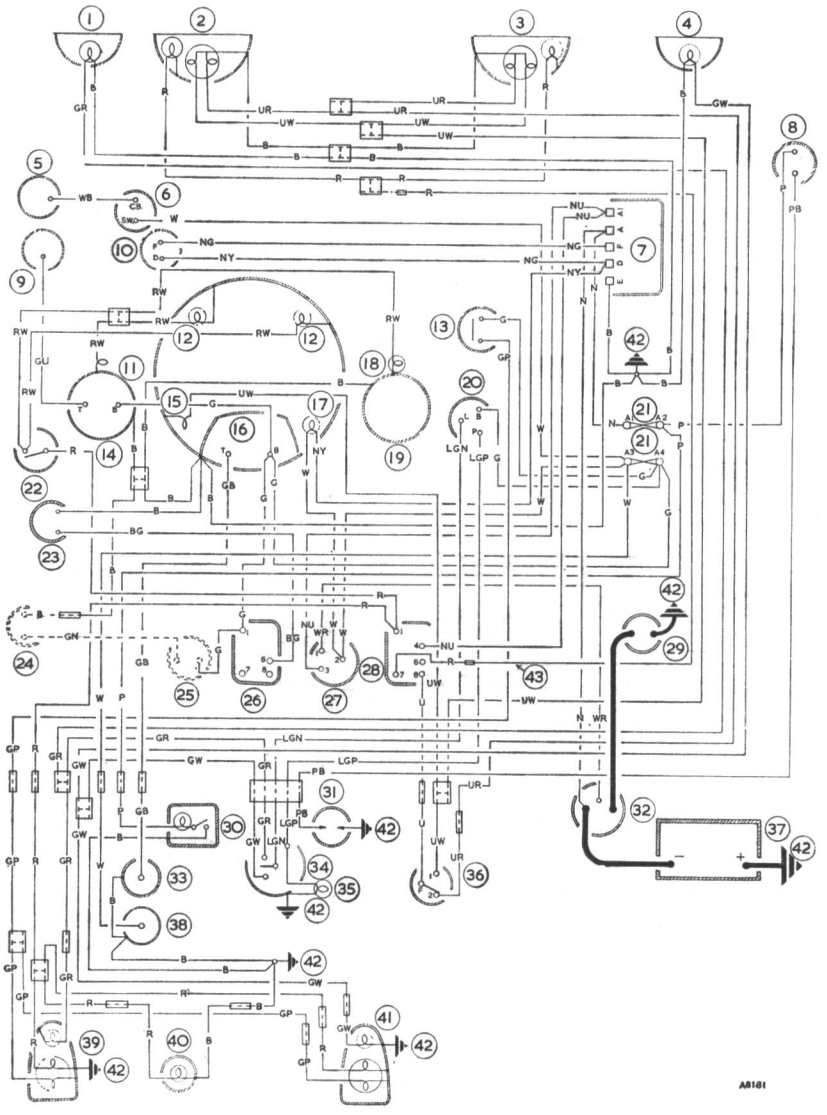

Fig. N.22

Wiring diagram (Super) up to 1964

1. L.H. flasher lamp.
2. L.H. headlamp and pilot lamp.
3. R.H. headlamp and pilot lamp.
4. R.H. flasher lamp.
5. Distributor.
6. Ignition coil.
7. Voltage regulator and cut-out.
8. Horn.
9. Thermo element.
10. Dynamo.
11. Thermo gauge illumination light.
12. Panel illumination lights.
13. Stop light switch.
14. Thermo gauge.
15. Main-beam warning light.
16. Fuel gauge.
17. Ignition warning light.
18. Oil gauge illumination light.
19. Oil gauge.
20. Flasher unit.
21. 35-amp. fuses.
22. Panel lights switch.
23. Wiper motor.
24. Heater motor.
25. Heater switch.
26. Wiper switch.
27. Ignition and starter switch.
28. Lighting switch.
29. Starter motor.
30. Interior lamp.
31. Horn-push.
32. Starter solenoid.
33. Tank unit.
34. Direction indicator switch.
35. Direction indicator warning light.
36. Dipper switch.
37. 12-volt battery.
38. Fuel pump.
39. L.H. stop, tail, and flasher lamp.
40. Number-plate illumination lamp.
41. R.H. stop, tail, and flasher lamp.
42. Earth connection.
43. Connect to terminal 6 for North America.

NOTE—On Export models the pilot lamps are combined with the flasher lamps.

CABLE COLOUR CODE

B. Black.	P. Purple.	Y. Yellow.
U. Blue.	R. Red.	L. Light.
N. Brown.	S. Slate.	D. Dark.
G. Green.	W. White.	M. Medium.

When a cable has two colour code letters the first denotes the main colour and the second denotes the tracer colour.

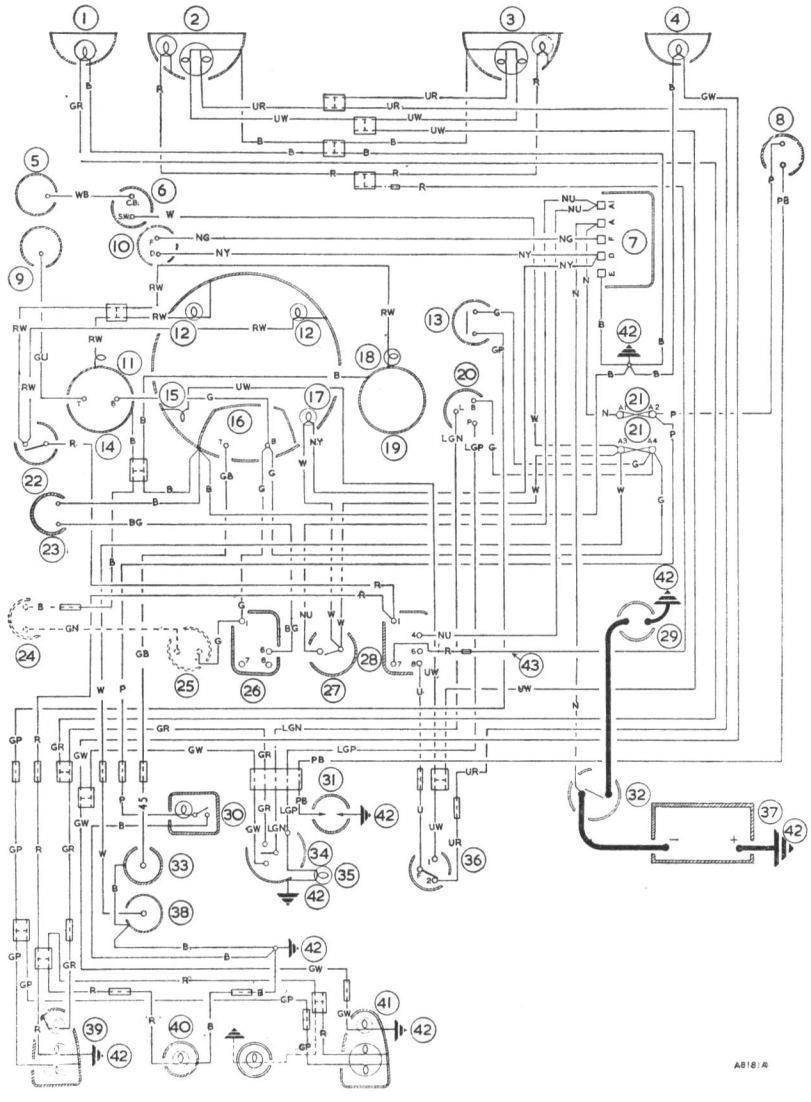

Fig. N.23

Wiring diagram (Super De-luxe, Traveller, and Countryman) up to 1964

1. L.H. flasher lamp.
2. L.H. headlamp and pilot lamp.
3. R.H. headlamp and pilot lamp.
4. R.H. flasher lamp.
5. Distributor.
6. Ignition coil.
7. Voltage regulator and cut-out.
8. Horn.
9. Thermo element.
10. Dynamo.
11. Thermo gauge illumination light.
12. Panel illumination lights.
13. Stop light switch.
14. Thermo gauge.
15. Main-beam warning light.
16. Fuel gauge.
17. Ignition warning light.
18. Oil gauge illumination light.
19. Oil gauge.
20. Flasher unit.
21. 35-amp. fuses.
22. Panel lights switch.
23. Wiper motor.
24. Heater motor.
25. Heater switch.
26. Wiper switch.
27. Ignition switch.
28. Lighting switch.
29. Starter motor.
30. Interior lamp.
31. Horn-push.
32. Starter.
33. Tank unit.
34. Direction indicator switch.
35. Direction indicator warning light.
36. Dipper switch.
37. 12-volt battery.
38. Fuel pump.
39. L.H. stop, tail, and flasher lamp.
40. Number-plate illumination lamp.
41. R.H. stop, tail, and flasher lamp.
42. Earth connection.
43. Connect to terminal 6 for North America.

NOTE.—On Export models the pilot lamps are combined with the flasher lamps.

CABLE COLOUR CODE

B. Black.	P. Purple.	Y. Yellow.
U. Blue.	R. Red.	L. Light.
N. Brown.	S. Slate.	D. Dark.
G. Green.	W. White.	M. Medium.

When a cable has two colour code letters the first denotes the main colour and the second denotes the tracer colour.

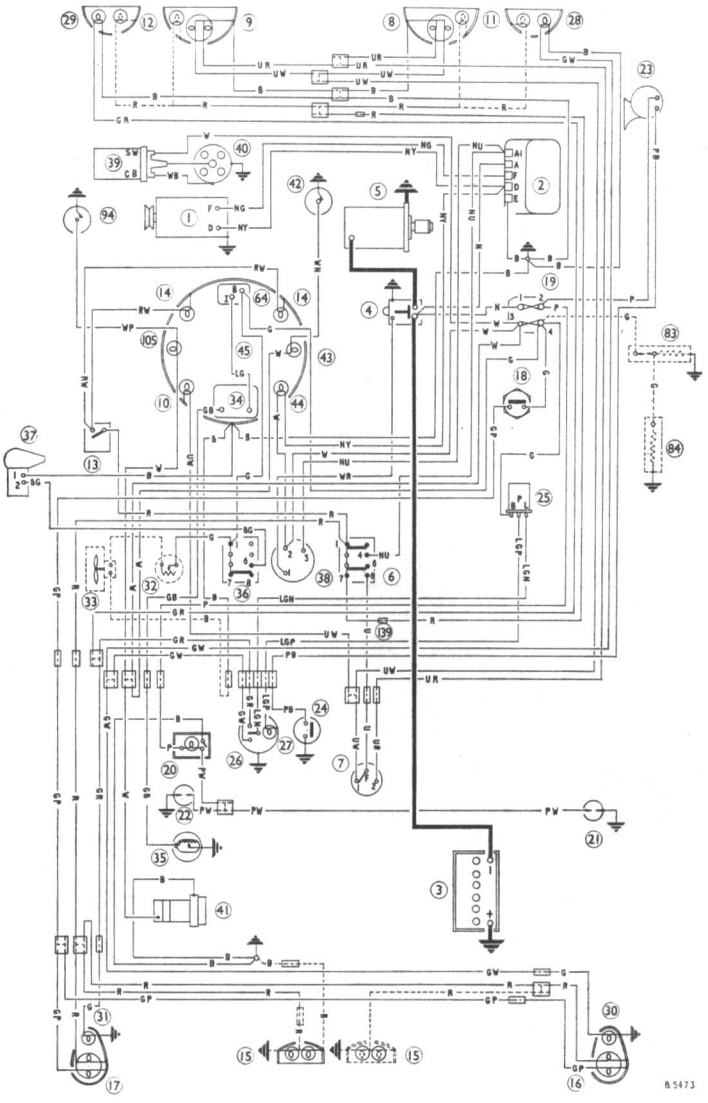

Fig. N.24

Wiring diagram (Saloon, Van, and Pick-up) 1964 onwards

1. Dynamo.
2. Control box.
3. 12-volt battery.
4. Starter solenoid.
5. Starter motor.
6. Lighting switch.
7. Headlamp dip switch.
8. R.H. headlamp.
9. L.H. headlamp.
10. Main-beam warning lamp.
11. R.H. sidelamp (in headlamp or flasher) lamp.
12. L.H. sidelamp (in headlamp or flasher) lamp.
13. Panel lamps switch.
14. Panel lamps.
15. Number-plate lamp (two for A/M/ADO15/W).
16. R.H. stop and tail lamp.
17. L.H. stop and tail lamp.
18. Stop lamp switch.
19. Fuse unit: 1–2 35 amp., 3–4 35 amp.
20. Interior light.
21. R.H. door switch.
22. L.H. door switch.
23. Horn.
24. Horn-push.
25. Flasher unit.
26. Direction indicator switch.
27. Direction indicator warning lamp.
28. R.H. front flasher lamp.
29. L.H. front flasher lamp.
30. R.H. rear flasher lamp.
31. L.H. rear flasher lamp.
32. Heater switch } when
33. Heater motor } fitted.
34. Fuel gauge.
35. Fuel gauge tank unit.
36. Windshield wiper switch.
37. Windshield wiper motor.
38. Ignition/starter switch.
39. Ignition coil.
40. Distributor.
41. Fuel pump.
42. Oil pressure switch.
43. Oil pressure warning lamp.
44. Ignition warning lamp.
45. Speedometer.
64. Bi-metal instrument voltage stabilizer.
83. Induction heater and thermostat (when fitted).
84. Suction chamber heater (when fitted).
94. Oil filter switch.
105. Oil filter warning lamp.
139. Connect to No. 6 for U.S.A. (alternative connection).

CABLE COLOUR CODE

B. Black.	G. Green.	W. White.
U. Blue.	P. Purple.	Y. Yellow.
N. Brown.	R. Red.	L.G. Light. Green

When a cable has two colour code letters the first denotes the main colour and the second denotes the tracer colour.

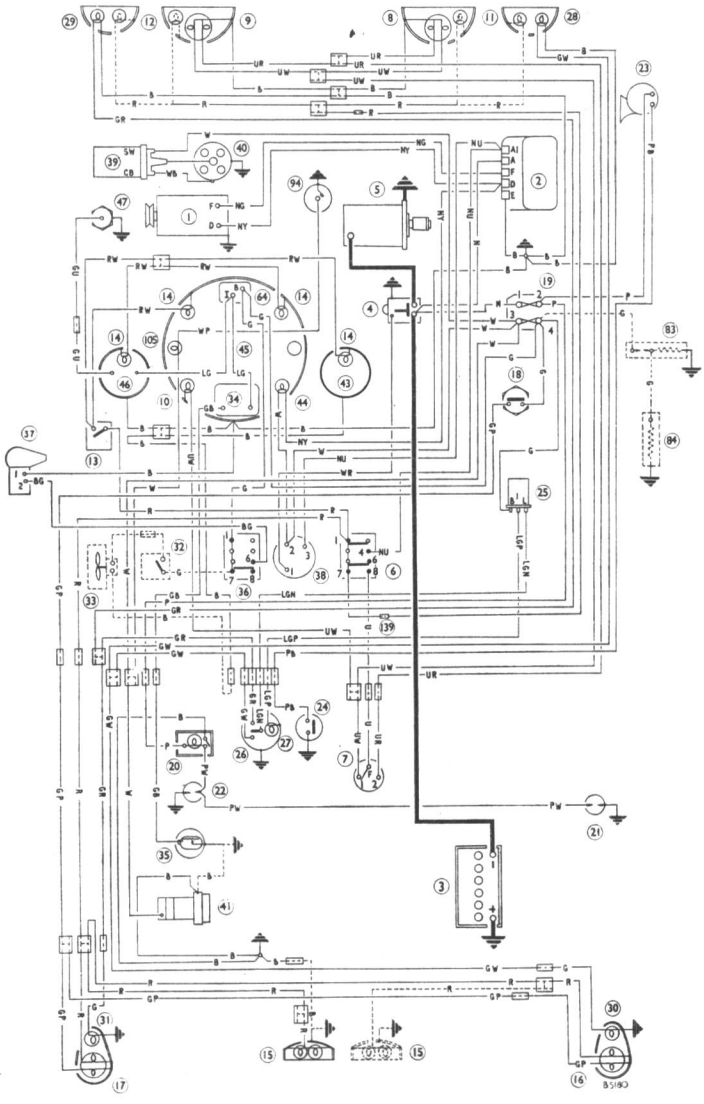

Fig. N.25

Wiring diagram (Traveller and Countryman) 1964 onwards

1. Dynamo.
2. Control box.
3. 12-volt battery.
4. Starter solenoid.
5. Starter motor.
6. Lighting switch.
7. Headlamp dip switch.
8. R.H. headlamp.
9. L.H. headlamp.
10. Main-beam warning lamp.
11. R.H. sidelamp (in headlamp or flasher) lamp.
12. L.H. sidelamp (in headlamp or flasher) lamp.
13. Panel lamps switch.
14. Panel lamps.
15. Number-plate lamp (two for A/M/ADO15/W).
16. R.H. stop and tail lamp.
17. L.H. stop and tail lamp.
18. Stop lamp switch.
19. Fuse unit: 1–2 35 amp., 3–4 35 amp.
20. Interior light.
21. R.H. door switch.
22. L.H. door switch.
23. Horn.
24. Horn-push.
25. Flasher unit.
26. Direction indicator switch.
27. Direction indicator warning lamp.
28. R.H. front flasher lamp.
29. L.H. front flasher lamp.
30. R.H. rear flasher lamp.
31. L.H. rear flasher lamp.
32. Heater switch } when
33. Heater motor } fitted.
34. Fuel gauge.
35. Fuel gauge tank unit.
36. Windshield wiper switch.
37. Windshield wiper motor.
38. Ignition/starter switch.
39. Ignition coil.
40. Distributor.
41. Fuel pump.
42. Oil pressure switch.
43. Oil pressure warning lamp.
44. Ignition warning lamp.
45. Speedometer.
64. Bi-metal instrument voltage stabilizer.
83. Induction heater and thermostat (when fitted).
84. Suction chamber heater (when fitted).
94. Oil filter switch.
105. Oil filter warning lamp.
139. Connect to No. 6 for U.S.A. (alternative connection).

CABLE COLOUR CODE

B. Black.	G. Green.	W. White.
U. Blue.	P. Purple.	Y. Yellow.
N. Brown.	R. Red.	L.G. Light Green.

When a cable has two colour code letters the first denotes the main colour and the second denotes the tracer colour.

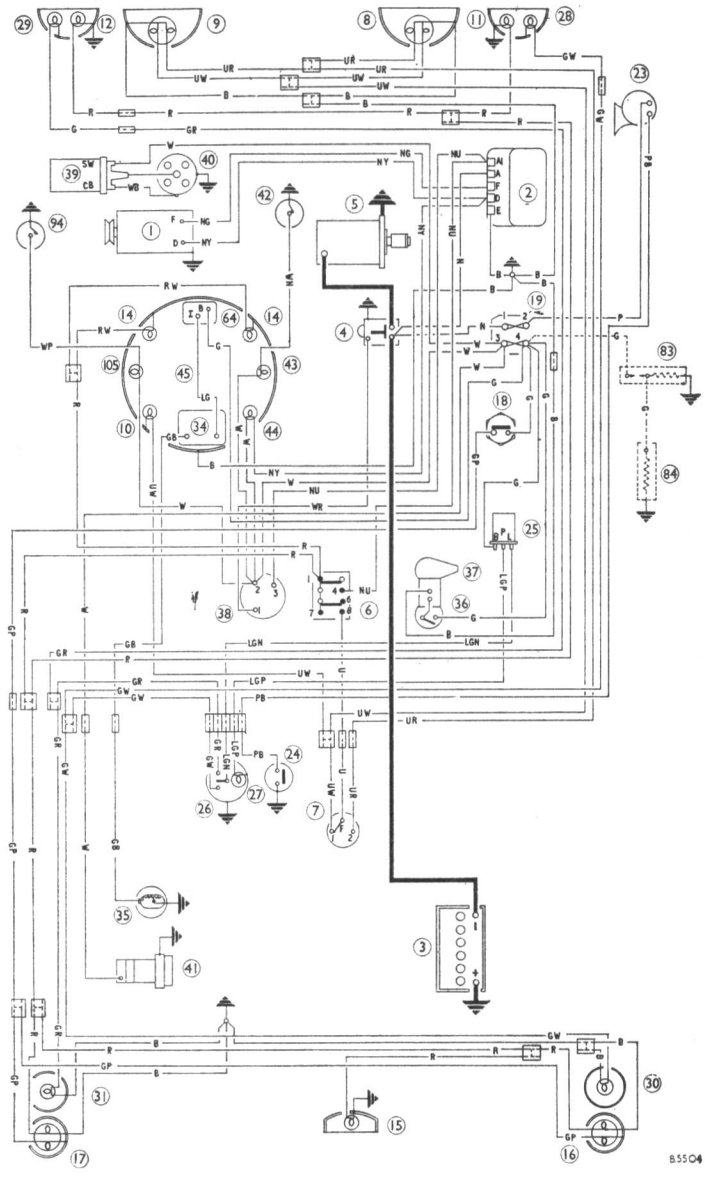

Fig. N.26

Wiring diagram (Moke)

1. Dynamo.
2. Control box.
3. 12-volt battery.
4. Starter solenoid.
5. Starter motor.
6. Lighting switch.
7. Headlamp dip switch.
8. R.H. headlamp.
9. L.H. headlamp.
10. Main-beam warning lamp.
11. R.H. sidelamp.
12. L.H. sidelamp.
14. Panel lamps.
15. Number-plate illumination lamp.
16. R.H. stop and tail lamp.
17. L.H. stop and tail lamp.
18. Stop lamp switch.
19. Two-way fuse unit: 1–2 35 amp., 3–4 35 amp.
23. Horn.
24. Horn-push.
25. Flasher unit.
26. Direction indicator switch.
27. Direction indicator warning lamp.
28. R.H. front flasher lamp.
29. L.H. front flasher lamp.
30. R.H. rear flasher lamp.
31. L.H. rear flasher lamp.
34. Fuel gauge.
35. Fuel gauge tank unit.
36. Windshield wiper switch.
37. Windshield wiper motor.
38. Ignition starter switch.
39. Ignition coil.
40. Distributor.
41. Fuel pump.
42. Oil pressure switch.
43. Oil pressure warning lamp.
44. Ignition warning lamp.
45. Speedometer.
64. Bi-metal instrument voltage stabilizer.
83. Induction heater and thermostat.
84. Suction chamber heater.
94. Oil filter switch.
105. Oil filter warning lamp.

CABLE COLOUR CODE

B. Black.	G. Green.	W. White.
U. Blue.	P. Purple.	Y. Yellow.
N. Brown.	R. Red.	L.G. Light Green.

When a cable has two colour code letters the first denotes the main colour and the second denotes the tracer colour.

SECTION O

THE WHEELS AND TYRES

(TUBELESS TYRES)

	Section
Tyre	
Fitting	O.5
Maintenance	O.1
Removal	O.4
Repairing	O.6
SP41 Radial Ply Tyres	O.7
Valves	O.2
Wheel—removing	O.3

Section O.1

TYRE MAINTENANCE

Even tyre wear is promoted by changing the positions of the tyres on the car at intervals of about 3,000 miles (4800 km.). The spare tyre should be brought into use with the others.

Attention should be paid to the following points with a view to obtaining the maximum mileage from the tyre equipment of the vehicle.

Test the pressures of the tyres daily by means of a suitable gauge and restore any air lost. It is not sufficient to make a visual inspection of the tyre for correct inflation. Inflate the spare wheel tyre to the correct front wheel pressure.

Keep the treads free from grit and stones and carry out any necessary repairs. Clean the wheel rims and keep them free from rust. Paint the wheels if necessary.

Keep the clutch and brakes adjusted correctly and in good order. Fierceness or uneven action in either of these units has a destructive effect upon the tyres.

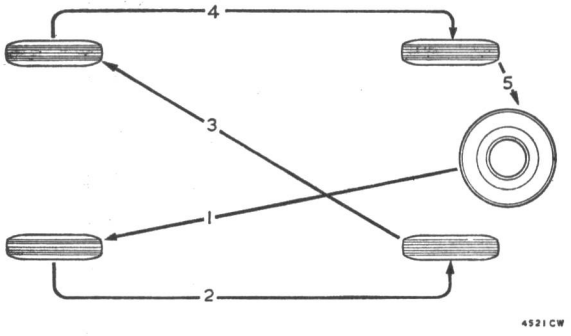

Fig. O.1

Interchange the road wheels diagonally in the order shown above, bringing the spare wheel into use

Misalignment is a very costly error. Suspect it if rapid wear of the front tyres is noticed and correct the fault at once. See Section J.4 for details on front wheel alignment.

Should the tyres get oily, fuel should be applied sparingly and wiped off at once.

Avoid under- and over-inflation.

Avoid kerbing and other causes of severe impact.

Have any damage repaired immediately.

Remove tyres when smooth for remoulding.

Section O.2

VALVES

A mushroom-headed rubber valve is used with tubeless tyres. The valve is secured in the wheel by a small stepped flange on the rubber valve and by the pressure of air inside the tyre.

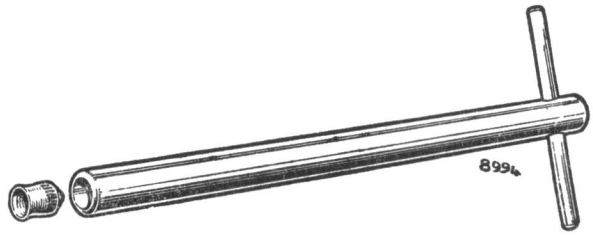

Fig. O.2

A simple tool for fitting tubeless tyre valves

A simple but effective tool (Fig. O.2) for fitting the valve can be made up from a 7 in. (177·8 mm.) length of $\frac{1}{2}$ in. (12·7 mm.) steel bar or 13 S.W.G. steel tubing. Using a letter 'S' (8·83 mm.) drill, in one end drill a hole to a depth of approximately $\frac{5}{8}$ in. (15·87 mm.).

Obtain a brass valve dust cap and solder the cap in the drilled hole.

The opposite end of the tool requires a hole drilling about $\frac{1}{2}$ in. (12·7 mm.) from the end to accept a short piece of $\frac{1}{4}$ in. (6·35 mm.) diameter rod to provide a handle.

To fit the valve with the aid of the tool first liberally coat the rubber valve and the perimeter of the valve hole in the wheel with soapy water. Insert the valve into the hole and screw on the special tool. A sharp pull will seat the valve correctly.

The valves may be tested for air-tightness by rotating the wheel until the valve is at the top and inserting the end of the valve in a small container of water. If bubbles appear the seating is faulty and the valve interior should be replaced with a new one. Valve caps, in addition to preventing dirt entering the valve, form a secondary air seal and should always be fitted.

Section O.3

REMOVING A ROAD WHEEL

Remove the hub cover on a Standard model by inserting the flattened end of the wheelbrace into the recess between the cover and the road wheel adjacent to the retaining lobes. Employ a twisting motion to the wheelbrace and not a levering movement.

On De-luxe models lever the cover away from the wheel with the blade of a screwdriver inserted between the lip of the cover and the wheel. Work carefully round the outer circumference until the cover is free. To refit the

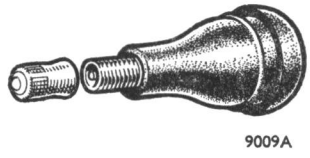

Fig. O.3

Valve for a tubeless tyre

cover place it on the wheel centre with the slot having the additional radius over the valve. Centralize the cover and give a sharp blow with the fist to force the cover retainers into the recess on the wheel.

On later De-luxe models the cover is removed with the flattened end of the wheelbrace and using the tyre as a fulcrum at a point diametrically opposite the tyre valve.

Apply the hand brake, slacken the four nuts securing the road wheel to the hub, and raise the car with the jack. Remove the nuts and take off the wheel. If wheel-changing is being undertaken on a hill it is advisable to scotch both front and rear wheels on the opposite side to prevent any possible movement when the car is on the jack and the wheel removed.

When refitting ensure that the wheel nuts are replaced with their chamfer against the wheel and are tightened in the order 1, 3, 4, 2 in rotation. Do not overtighten; the correct torque figure as given in **'GENERAL DATA'** must not be exceeded.

Section O.4

TYRE REMOVAL

Remove the valve interior to deflate the tyre completely.

Using spoon-shaped tyre levers, which must be in good condition, separate the beads from the rim flange in the manner shown in Fig. O.4 until both beads are in the base of the rim. As inextensible wires are incorporated in the edges of the tyres, no attempt should be made to stretch the edges over the rim as the beads must **IN NO WAY BE DAMAGED.**

Owing to the construction of the wheel the tyres must be removed over the narrow bead seat of the wheel only. **Tyres cannot be removed or refitted over the wide flange.**

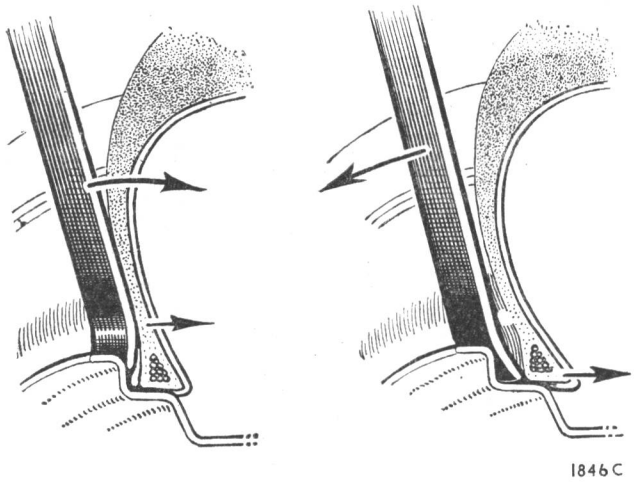

Fig. O.4

The tyres have wire edges and no attempt must be made to stretch them. If the cover fits tightly on the rim seating it should be freed by using the tyre levers as indicated

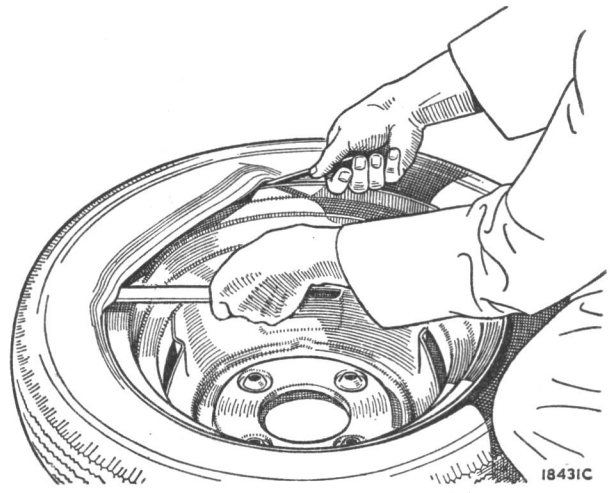

Fig. O.5

Lever the cover over the rim, using tyre levers in good condition to avoid damaging the sealing edge of the tyre

Push both cover edges into the well-base of the wheel and lubricate the tyre beads and the fitting levers with Dunlop Tyre Bead Lubricant or a thin vegetable oil soap solution. Commence at a point diametrically opposite and lever the cover edge over the inner rim of the wheel, using two levers at intervals of 6 in. (15 cm.) apart. Continue working round the wheel until the cover on one side is completely free.

Section O.5

TYRE FITTING

The tubeless tyre relies primarily on a good air seal between the tyre bead and the rim, and also between the rim and the valve. Great care is therefore necessary to avoid the slightest damage to the tyre bead. If the narrow bead seat is on the inside of the wheel the tyre must be mounted over the inner rim flange. The following instructions are of great importance.

Rim preparation

(1) Remove any visible dents in the flange by careful hammering.

(2) Clean the flange and rim seat with steel wool, emery, or other cleaning medium and remove all foreign matter, rust, rubber, etc., Paint need not be removed but irregularities in the surface should be smoothed out. In extreme cases of rusting it may be necessary to use a wire brush or a file.

(3) File or buff away any high-spot at the butt-weld joint.

(4) Wipe the flange and bead seat with a water-moistened cloth.

Before fitting moisten the beads of the tyre, the rim flange, and the tyre levers with Dunlop Tyre Bead

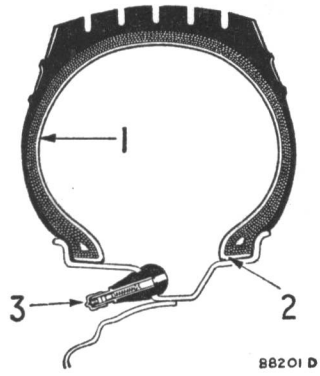

Fig. O.6

A section through a tubeless tyre

1. Air retaining liner.
2. Rubber air seal.
3. Rubber-sealed valve.

Lubricant or a thin vegetable oil soap solution; **do not use fuel.** Mount the tyre on the inner rim and push one edge of the cover over the edge of the rim; continue working round the tyre towards the valve position. The portion of the tyre first fitted should be kept pushed into the well-base of the wheel rim and then no difficulty will be encountered in fitting the last portion of the cover. Do not forget that the white or coloured balance spot on the tyre must be line with the valve position.

Before inflation bounce the crown of the tyre on the ground at various points to snap home the beads of the tyre against the rim of the wheel and provide a partial seal. Refit the valve interior.

With the wheel in an upright position inflate the tyre. If a seal cannot be obtained at the first rush of air bounce the tyre again with the air-line attached. In cases of difficulty apply a tourniquet of strong cord around the circumference of the tyre and tighten. Inflate to a maximum of 40 lb./sq. in. (2·8 kg./cm.²) until the beads are fully seated against both rim flanges. Do not inflate to a greater pressure than stated.

If a pressure of 40 lb./sq. in. (2·8 kg./cm.²) will not seat the beads properly, deflate, lubricate the beads and rim with Tyre Bead Lubricant, centralize the tyre, and re-inflate. If the second attempt is unsuccessful, the wheel rim circumference is suspect and should be checked with a rim gauge if available, or replaced with a new wheel.

Allow the tyre to stand for a few minutes so that any free air trapped between the flange and the bead clinch can escape. Test the complete assembly in a water tank, paying special attention to the areas at the beads, valve, and wheel rivets.

After the beads have seated properly and the leak test is satisfactory, deflate the tyre to its correct running pressure.

Sealing leaks located during testing

Loss of air may occur at any or all of the following points:

(1) The area of the bead seat, showing as a leak at the top of the flange. This is usually due to a high-spot on the rim and can usually be cured by holding the bead away from the rim to allow further cleaning.

(2) The wheel rivets. In this case, and in extreme cases of leakage in the area of the bead seat (paragraph 1), it is necessary to remove the tyre. Before doing so mark the position of the leak on the tyre and rim.

Loss of air at the rivets can be cured by peening over the rivet heads.

(3) The base of the valve or the valve interior. Provided the valve is correctly fitted, this may be due to dirt under the valve seat. Clean the valve seat and fit a new valve interior.

Inflate the tyre to the correct pressure before fitting the wheel assembly to the vehicle and driving.

Section O.6

REPAIRING TYRES

Penetrations

Normally a tubeless tyre will not leak as the result of penetration by a nail or other puncturing object, provided that it is left in the tyre. It is necessary to examine the tyres periodically and to withdraw such objects at a time when loss of air pressure will cause least inconvenience.

Use of plugging kit—location and preparation

If a hole fails to seal mark the spot and extract the puncturing object, taking note of the direction of penetration. If the tyre is leaking and the puncturing object cannot be located by sight it is necessary to immerse the inflated tyre in water.

Dip the plugging kit needle into the flask of solution and insert it into the hole in the tyre, following the same direction as the penetration.

Repeat the operation until the hole is well lubricated with solution.

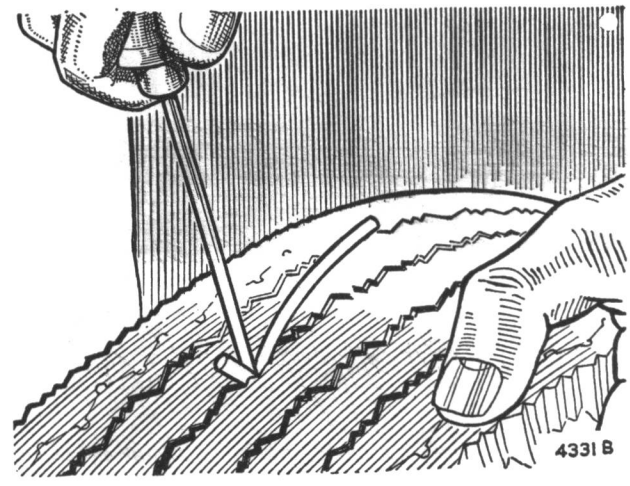

Fig. O.7

Inserting the plug and needle through a hole in the tyre

Repair

Select a plug about twice the diameter of the puncturing object, stretch it, and roll it into the eye of the needle $\frac{1}{4}$ in. (6·35 mm.) from the end. After dipping the plug into the solution insert the needle into the hole and push the plug through the tyre (Fig. O.7.)

Withdraw the needle and cut off surplus plug about $\frac{1}{8}$ in. (3·18 mm.) from the surface of the tread (Fig. O.8). The tyre can now be inflated and used immediately. More severe injuries which are outside the scope of simple puncture repair methods are dealt with in nearly the same way as similar injuries to conventional covers.

If the tyre deflates on the road following an unusually large penetration a tube can be fitted to enable the owner to remain on the road until it is convenient for the necessary repairs to be carried out. (The valve used for the tubeless tyre must be removed before the fitting of the tube).

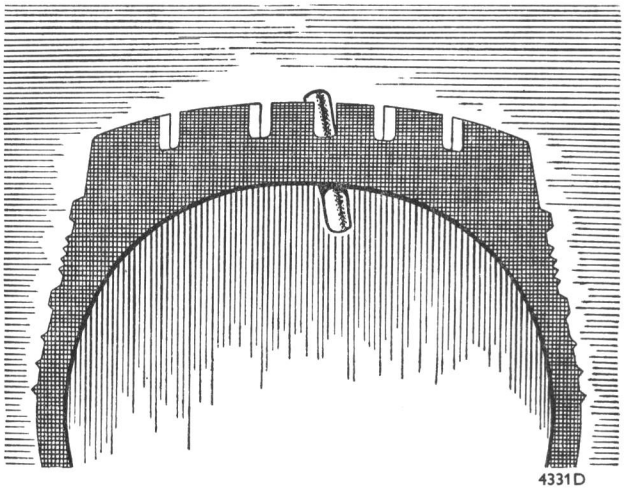

Fig. O.8

The plug inserted in the tyre and cut off to the correct length

Section O.7

SP 41 RADIAL PLY TYRES

Tyre replacement

It is stressed that all tyres must be of the same constructional type at all times. Tyres of radial ply construction (e.g. Dunlop SP) should not be mixed with tyres of conventional construction (e.g. Dunlop C41) since this would result in the handling of the car being seriously impaired. Inflate the tyres to the correct pressures (see **'GENERAL DATA'**).

SECTION P

LUBRICATION

	Section
Engine and transmission unit	P.2
Carburetter damper	
Oil change	
Engine oil filter	
Dynamo	
Water pump	
Distributor	
Steering, suspension, brake cables..	P.3
Greasing points	
Hand brake cable sectors	
Key to Recommended Lubricants..	P.1

Correct lubrication of any piece of mechanism is of paramount importance, and in no instance is it of greater importance than in the correct choice of lubricant for a motor-car engine. Automobile engines have different characteristics, such as operating temperatures, oiling systems, size of oilways, clearances, and similar technicalities, and the use of the correct oil is therefore essential.

NOTE.—The letters given in parentheses throughout the Manual refer to the appropriate section of the recommended lubricants table given on page P.2.

Section P.1

KEY TO RECOMMENDED MONOGRADE LUBRICANTS

	A			B	C	D	E
Component	Engine/Transmission Unit			Steering Gear	Wheel Hubs and all Grease Points	Oilcan and Carburetter	Upper Cylinder Lubrication
Climatic conditions	**Tropical and temperate down to 0° C. (32° F.)**	**Extreme cold down to —12° C. (10° F.)**	**Arctic consistently below —12° C. (10° F.)**	**All conditions**	**All conditions**	**All conditions**	**All conditions**
MOBIL	Mobiloil A	Mobiloil Arctic	Mobiloil 10W	Mobilube G.X. 140	Mobilgrease M.P.	Mobiloil Arctic	Mobil Upperlube
BP	Energol S.A.E. 30	Energol S.A.E. 20W	Energol S.A.E. 10W	Energol E.P. S.A.E. 140	Energrease L. 2	Energol S.A.E. 20W	Energol U.C.L.
SHELL	Shell X—100 30	Shell X—100 20W	Shell Rotella 10W or X—100 10W	Shell Spirax 140 E.P.	Shell Retinax A	Shell X—100 20W	Shell Upper Cylinder Lubricant
FILTRATE	Filtrate Medium 30	Filtrate Zero 20/20W	Filtrate Sub-Zero 10W	Filtrate E.P. Gear 140	Filtrate Super Lithium Grease	Filtrate Zero 20/20W	Filtrate Petroyle
STERNOL	Sternol W.W. 30	Sternol W.W. 20	Sternol W.W. 10	Ambroleum E.P. 140	Ambroline L.H.T.	Sternol W.W. 20	Sternol Magikoyl
DUCKHAM'S	Duckham's NOL Thirty	Duckham's NOL Twenty	Duckham's NOL Ten	Duckham's NOL E.P. 140	Duckham's L.B. 10 Grease	Duckham's NOL Twenty	Duckham's Adcoid Liquid
CASTROL	Castrol X.L.	Castrolite	Castrol Z	Castrol Hi-Press	Castrolease L.M.	Castrolite	Castrollo
ESSO	Esso Extra Motor Oil 20W/30	Esso Extra Motor Oil 20W/30	Esso Motor Oil 10	Esso Gear Oil G.P. 140	Esso Multipurpose Grease H	Esso Extra Motor Oil 20W/30	Esso Upper Cylinder Lubricant

Multigrade motor oils

In addition to the recommended lubricants listed above we approve the use of these motor oils, as produced by the oil companies shown in our Manuals, for all climatic conditions unless the engine is in poor mechanical condition.

KEY TO RECOMMENDED MULTIGRADE LUBRICANTS

	A and D
Component	Engine/Transmission Unit, Oilcan, and Carburetters
Climatic conditions	**All temperatures above —17·8° C. (0° F.)**
MOBIL	Mobiloil Special
BP	B.P. Energol Visco-Static
SHELL	Shell X—100 Multigrade 10W/30
FILTRATE	Filtrate 10W/30 Multigrade
STERNOL	Sternol Multiplic
DUCKHAM'S	Q5500
CASTROL	Castrolite*
ESSO	Esso Extra Motor Oil 20W/30*

Approval is also given to Duckham's Q.20–50 and to monograde or single-viscosity conventional lubricants supplied by companies listed in this publication.

* For temperatures below —12·2° C. (10° F.) use the S.A.E. 10W/30 grade oil. This is available in markets where such low temperatures prevail.

RECOMMENDED MONOGRADE LUBRICANTS

	A			B	C	D	E
Component	Engine/Transmission Unit			Steering Gear	Wheel Hubs and all Grease Points	Oilcan and Carburetter	Upper Cylinder Lubrication
Climatic conditions	**Tropical and temperate down to 0° C. (32° F.)**	**Extreme cold down to —12° C. (10° F.)**	**Arctic consistently below —12° C. (10° F.)**	**All conditions**	**All conditions**	**All conditions**	**All conditions**
BP	Energol S.A.E. 30	Energol S.A.E. 20W	Energol S.A.E. 10W	Energol E.P. S.A.E. 140	Energrease L. 2	Energol S.A.E. 20W	Upper Cylinder Lubricant
SHELL	Shell X—100 30	Shell X—100 20W	Shell Rotella 10W or X—100 10W	Shell Spirax 140 E.P.	Shell Retinax A	Shell X—100 20W	Shell Upper Cylinder Lubricant
FILTRATE	Filtrate Medium 30	Filtrate Zero 20/20W	Filtrate Sub-Zero 10W	Filtrate E.P. Gear 140	Filtrate Super Lithium Grease	Filtrate Zero 20/20W	Filtrate Petroyle
STERNOL	Sternol W.W. 30	Sternol W.W. 20	Sternol W.W. 10	Ambroleum E.P. 140	Ambroline L.H.T.	Sternol W.W. 20	Sternol Magikoyl
DUCKHAM'S	Duckham's NOL Thirty	Duckham's NOL Twenty	Duckham's NOL Ten	Duckham's NOL E.P. 140	Duckham's L.B. 10 Grease	Duckham's NOL Twenty	Duckham's Adcoid Liquid
CASTROL	Castrol X.L.	Castrolite	Castrol Z	Castrol Hi-Press	Castrolease L.M.	Castrolite	Castrollo
ESSO	Esso Extra Motor Oil 20W/30	Esso Extra Motor Oil 20W/30	Esso Motor Oil 10	Esso Gear Oil G.P. 140	Esso Multipurpose Grease H	Esso Extra Motor Oil 20W/30	Esso Upper Cylinder Lubricant
MOBIL	Mobiloil A	Mobiloil Arctic	Mobiloil 10W	Mobilube G.X. 140	Mobilgrease M.P.	Mobiloil Arctic	Mobil Upperlube

Multigrade motor oils

In addition to the recommended lubricants listed above we approve the use of these motor oils, as produced by the oil companies shown in our Manuals, for all climatic conditions unless the engine is in poor mechanical condition.

RECOMMENDED MULTIGRADE LUBRICANTS

	A and D
Component	Engine/Transmission Unit, Oilcan, and Carburetters
Climatic conditions	**All temperatures above —17·8° C. (0° F.)**
MOBIL	Mobiloil Special
BP	Visco-Static
SHELL	Shell Super Motor Oil
FILTRATE	Filtrate 10W/30 Multigrade
STERNOL	Sternol W.W. Multigrade 10W/40
DUCKHAM'S	Q5500
CASTROL	Castrolite
ESSO	Esso Extra Motor Oil

Approval is also given to Duckham's Q.20–50, BP Visco-Static Longlife Oil and to monograde or single-viscosity conventional lubricants supplied by companies listed in this chart.

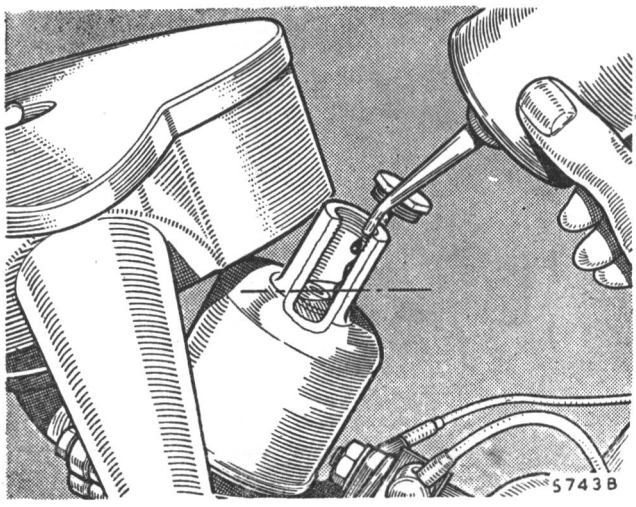

Fig. P.1

Use thin engine oil to lubricate the carburetter piston damper. Maintain the oil level within ½ in. (13 mm.) of the top of the hollow piston rod

Section P.2

ENGINE AND TRANSMISSION UNIT

Inspect the oil level in the engine transmission unit, and refill if necessary to the 'MAX' mark on the dipstick, using oil to Ref. A (page P.2). The oil filler cap is on the top of the valve rocker cover and is released by turning it anti-clockwise.

CARBURETTER DAMPER (D)

Unscrew the cap from the top of the suction chamber, top up with thin engine oil to the correct level, and replace the cap. Under no circumstances should a heavy-bodied lubricant be used. Failure to lubricate the damper will cause the piston to flutter and reduce acceleration.

Oil to Ref. D (page P.2) should be used.

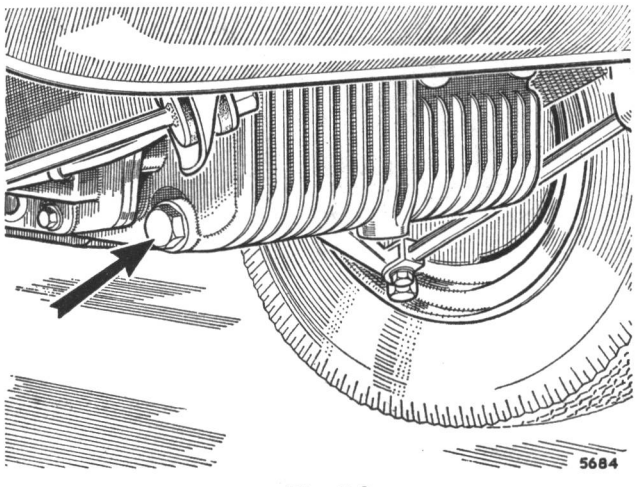

Fig. P.2

The transmission casing drain plug

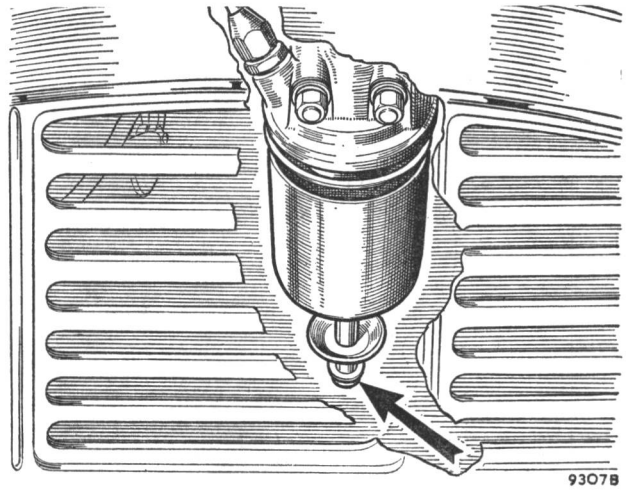

Fig. P.3

The oil filter bowl retaining bolt

OIL CHANGE (A)

Drain the oil from the engine/transmission unit. The sump plug should be removed after a journey when the oil is still warm and will drain easily. Thoroughly clean the drain plug before it is refitted.

Refill the engine/transmission unit with oil to Ref. A (page P.2).

ENGINE OIL FILTER

Unscrew the central bolt to release the oil filter bowl, withdraw the element, wash the bowl in fuel, and fit a new element. Take care to fit the washer below the element inside the bowl correctly. The small felt washer must be positioned between the element pressure plate and the metal washer above the pressure spring. It is essential for correct oil filtration that the felt washer should be in good condition and a snug fit on the centre-securing bolt.

Make certain that the seating washer for the filter bowl is in good condition and that the bowl is fitted securely to prevent oil leaks.

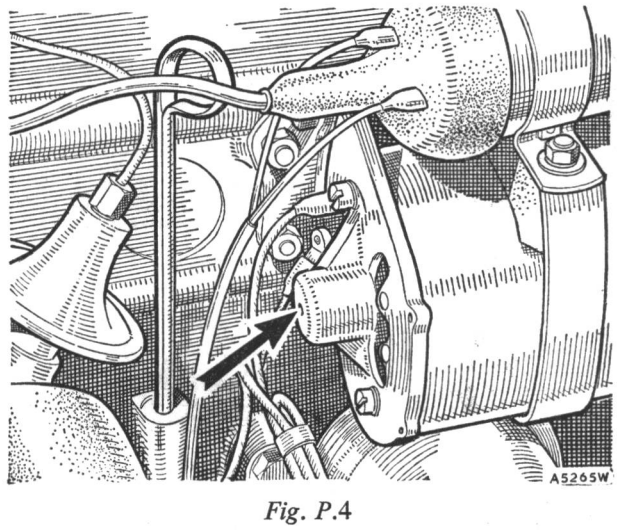

Fig. P.4

The dynamo end bearing lubricating aperture

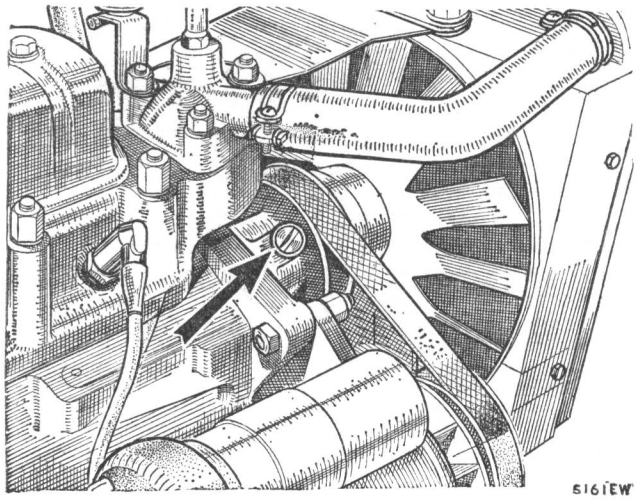

Fig. P.5

The water pump lubricating hole; remove the screw indicated and lubricate sparingly

DYNAMO (D)

Add two drops of engine oil to Ref. D (page P.2) in the lubrication hole in the centre of the rear end bearing plate.

Do not over-oil.

WATER PUMP (C)

Remove the oiling plug on the water pump casing and add a small quantity of grease to Ref. C (page P.2). Lubrication of the pump must be done very sparingly, otherwise grease will penetrate past the bearings onto the face of the carbon sealing ring and impair its efficiency.

DISTRIBUTOR

Cam bearing (D)

Lift the rotor off the top of the spindle by pulling it squarely and add a few drops of thin engine oil to Ref. D (page P.2) to the cam bearing. Do not remove the screw

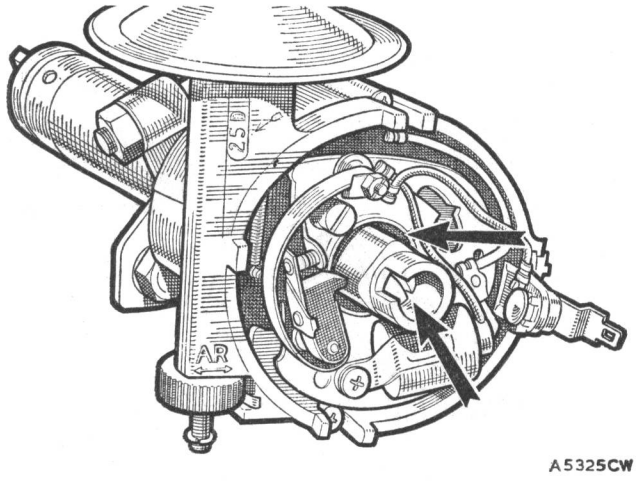

Fig. P.6

The distributor cam bearing and automatic advance control lubricating points

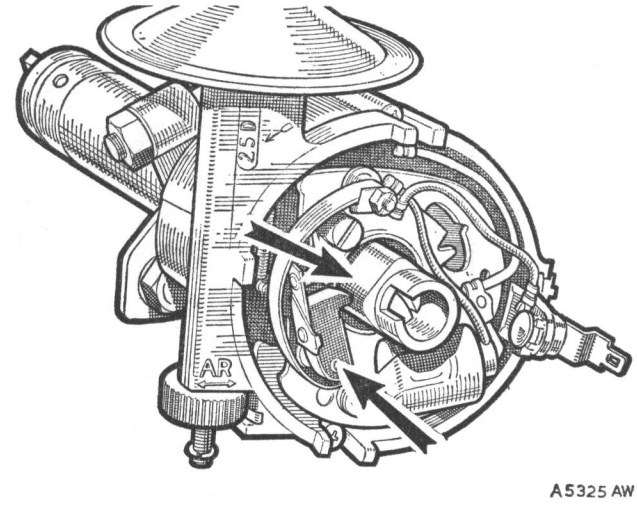

Fig. P.7

The distributor cam spindle and contact breaker lubricating points

which is exposed when the rotor arm is removed. There is a clearance between the screw and the inner face of the spindle for the oil to pass.

Replace the rotor with its drive lug correctly engaging the spindle slot and push it onto the shaft as far as it will go.

Cam (C)

Lightly smear the cam with a very small amount of grease to Ref. C (page P.2), or if this is not available clean engine oil can be used.

Automatic timing control (D)

Carefully add a few drops of thin engine oil to Ref. D (page P.2) through the hole in the contact breaker base through which the cam passes. Do not allow the oil to get on or near the contacts. Do not over-oil.

Contact breaker pivot (D)

Add a spot of engine oil to Ref. D (page P.2) to the moving contact pivot pin.

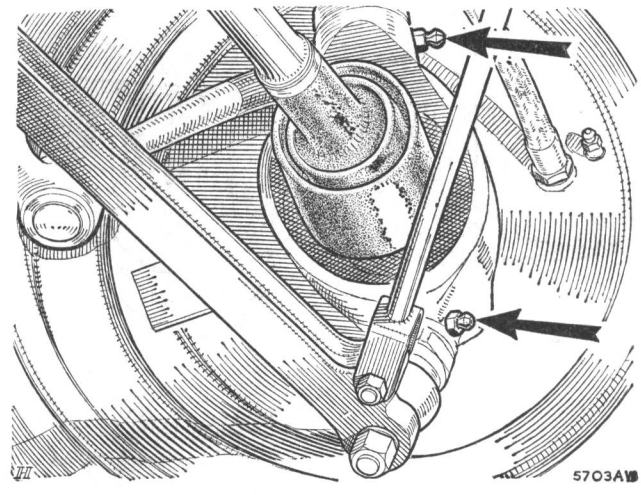

Fig. P.8

The swivel hub lubricating nipples

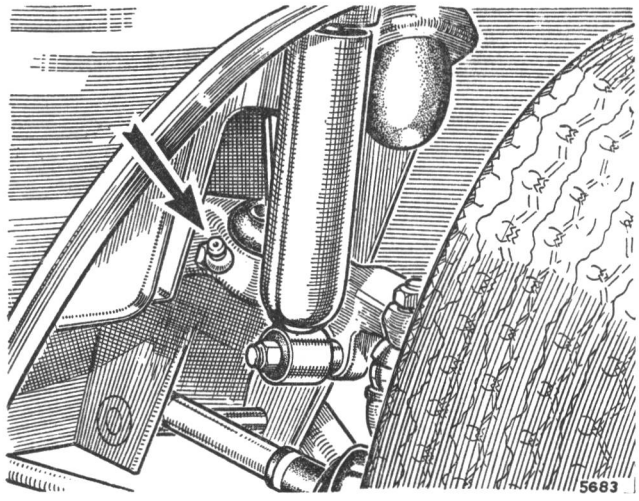

Fig. P.9
The upper suspension arm pivot lubricating nipple

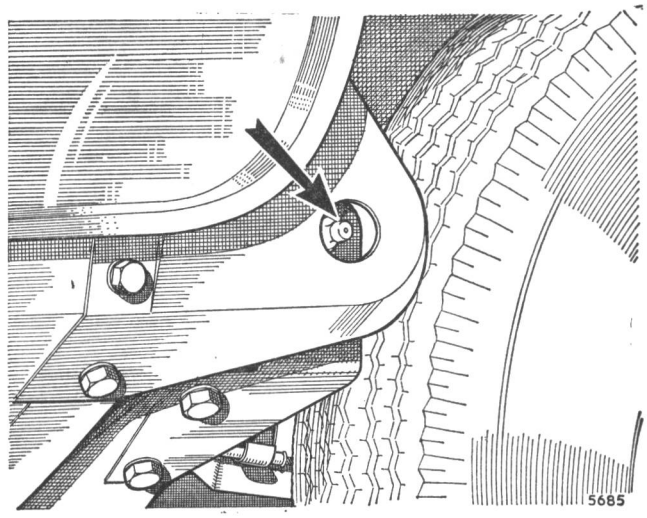

Fig. P.10
The rear radius arm lubricating nipple

Section P.3

STEERING, SUSPENSION, BRAKE CABLES

Lubricating nipples are located at the following points; a grease gun filled with grease to Ref. C (page P.2) should be applied to the nipples and given three or four strokes.

(1) Upper and lower steering swivel knuckles (two each side). Jack up the front of the vehicle to take the load off the swivel knuckles and make certain that the lubricating nipples are clean and are not blocked with road dirt. If the knuckles are already filled with grease no further grease can usually be forced in.

(2) Swivel hub upper support arm pivot (one nipple each side).

(3) Rear radius arm (one nipple on each arm). The grease gun must be applied to the nipple on the rear radius arm and operated there until the grease exudes from the inner bush.

(4) Drive shaft sliding joint (one nipple on each shaft, fitted to early models only).

In addition to the above greasing points the hand brake cable guide tubes on the rear radius arm of cars up to Car Nos. AA2S7 5715, AA2S7L 5537, and MA2S4 5487 should also receive a liberal application of grease.

HAND BRAKE CABLE SECTOR PIVOTS
(From Car Nos. AA2S7 5715, AA2S7L 5537, and MA2S4 5487)

These are of two distinct types. The early type fitted to vehicles prior to the following car numbers should be lubricated with oil to Ref. D:

Saloon: AA2S7 156620, AA2S7L 160079, MA2S4 89785.

Countryman/Traveller: AAW7 156302, AAW7L 161027, MAW4 159677, MAW4L 159396.

Van: AAV7 15996, AAV7L 159994, MAV4 161548, MAV4L 160809.

Pick-up: AAU7 159348, AAU7L 158860, MAU4 161182, MAU4L 150027.

The type of sector fitted after these car numbers was equipped with a self-lubricating bush and requires no regular maintenance unless brake drag is suspected, in which case the bush should be lightly lubricated with oil to Ref. D.

NOTE.—The periods at which the instructions in this Section should be carried out are contained in the Passport to Service or Driver's Handbook.

SECTION R

THE BODY

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Body	
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Torch-soldering	R.4
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Bodywork and upholstery	R.12
Bumpers	R.11
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Quarter-light	R.8
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Fitting instructions (recirculatory type)	R.15
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Tilt frame and cover (Pick-up)	R.25
Windshield washer	R.17
Windshield (Moke)	R.35

Section R.1

REPAIR PROCEDURE

Body jack

The specially designed body jack, obtainable under Part No. 18G 308 B, is an essential item when rectifying any misalignment of the body construction. The jack is provided with a ratchet turnscrew, and the pitch of the centre spindle thread is such that considerable force (either pulling or pushing) can be exerted. The extension pieces are made from solid drawn steel tubes and their lengths are such that the effective length of the jack can be made to vary between 21 and 94 in. (533 and 2388 mm.).

When using the jack care must be taken to use it in the correct positions to rectify the fault or misalignment. Reference should be made to pages R.27 and R.28 for details of the necessary alignment checks.

With the addition of a suitable oxy-acetylene outfit (Section R.3) any type of mono-construction repair can be effected. The initial outlay need only be small, and, considering the wide range of operations covered, there should be no hesitation in deciding that the kit must figure as part of the equipment of your repair shop.

Rectification of buckled panels or underframe

Experience will prove that parts of the body which at first sight would be considered beyond repair can be rectified easily by the use of the body jack.

It is of paramount importance to return the damaged portion of the body to its original position before deciding whether replacement panels are necessary or not.

With the use of the special jack this method enables a buckled or damaged structure to be returned to its original relative position without straining the surrounding metal, which would be the inevitable result if the damaged portion were pounded by means of a hammer.

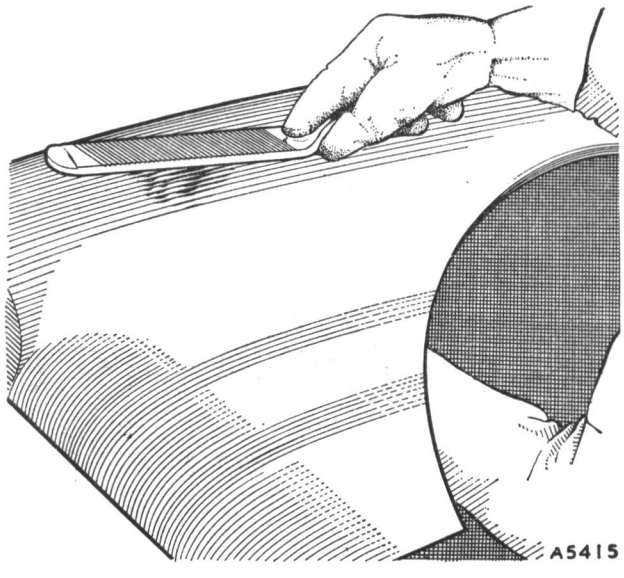


Fig. R.1

Removing a dent by tapping with a spoon; a dolly is held below the dent

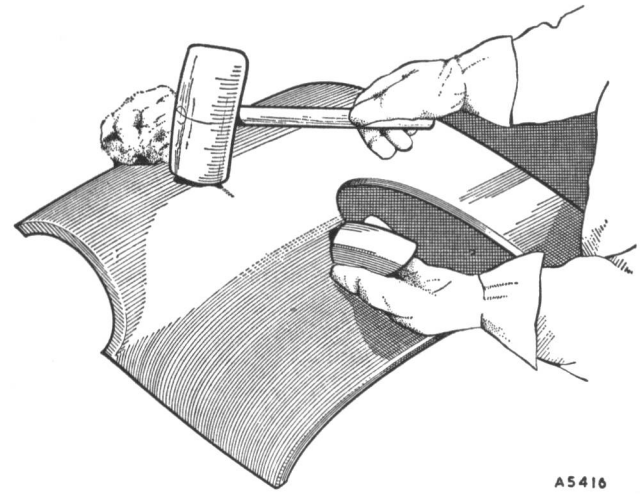


Fig. R.2

A dolly block and mallet

At this stage a decision can be reached as to whether any damaged panel is to be repaired or renewed.

Spoon for removal of small dents

To remove small dents a spoon which is made from a coarse-cut file, specially shaped and having the teeth intact, is used in conjunction with a suitably shaped dolly block (Fig. R.1).

The use of a hammer to remove small dents is to be deprecated, as hammer-blows tend to stretch the surrounding metal, giving rise to further complications. It is for this reason that the spoon is recommended, as by its use a depression can be raised to its original level without stretching.

On panel work such as doors, or where inside reinforcements prevent the use of a dolly block, a hole can be punched or drilled through the inside panel and a suitable drift pin, about $\frac{1}{2}$ in. (12·7 mm.) in diameter, used in conjunction with the spoon in place of the dolly block.

Sharper dents or a dent or collection of dents covering a large area will require the use of heat, a dolly, and a spoon in the following manner.

With the welding torch heat a small area at the outside of the collection of dents, then, holding the dolly below, hammer the raised portion with a wooden mallet. When the metal cools remove the dolly and place a large handful of wet asbestos over the heated area to prevent the heat spreading. Continue to heat and tap, working from the outside of the damage area, until something like the original contour and level is attained.

Lightly file the surface to show up the high-spots and remove these with the dolly and spoon without further heating.

Take care when using the file not to thin the metal more than is necessary to show up the high-spots.

Alternate checking by filing and raising with the dolly block and spoon will eventually produce a flat and clean surface without weakening the metal unduly, provided excessive filing is avoided. Care should be

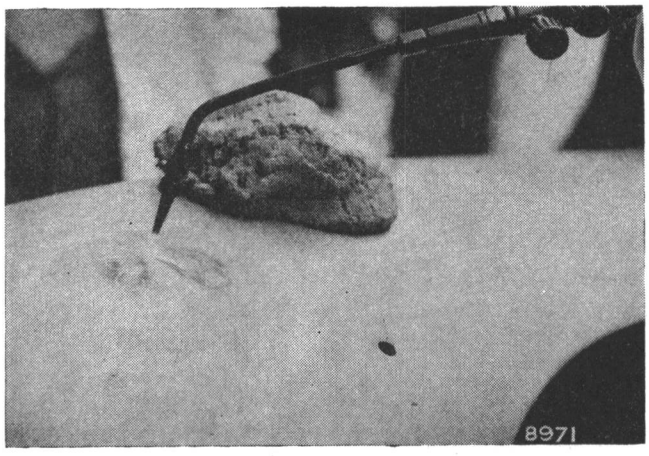


Fig. R.3
Heating the damaged area before tapping with a mallet

exercised to reduce filing to a minimum as otherwise the thickness of the panel will be seriously reduced.

On completion, the surface may be tinned and any small indentations filled with plumber's solder.

Preservation of paintwork

A special spoon, having the teeth removed and its surface planished and polished, is required to enable small dents to be removed without damage to paintwork. Where it is possible to preserve paintwork when rectifying comparatively large dents a sandbag should be placed against the painted surface of the panel and the dent removed from the under side by the use of a wooden mallet. A suitable sandbag for this operation may be made from a leather oval bag 8 in. (203 mm.) long, 6 in. (152 mm.) wide, and 4 in. (102 mm.) thick which is packed tightly with sand.

Stretched panels

Stretched panels which are liable to cause drumming can be rectified by local shrinking. A liberal heap of wet asbestos is placed over the stretched panel at the point of greatest resiliency, and a hole just large enough to apply

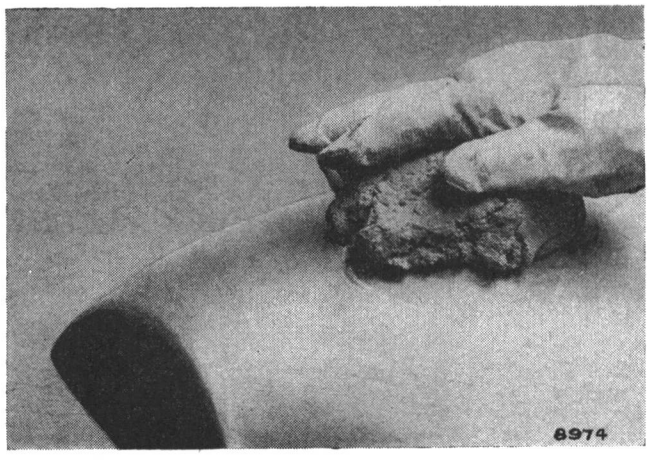


Fig. R.4
Cooling the damaged area with wet asbestos

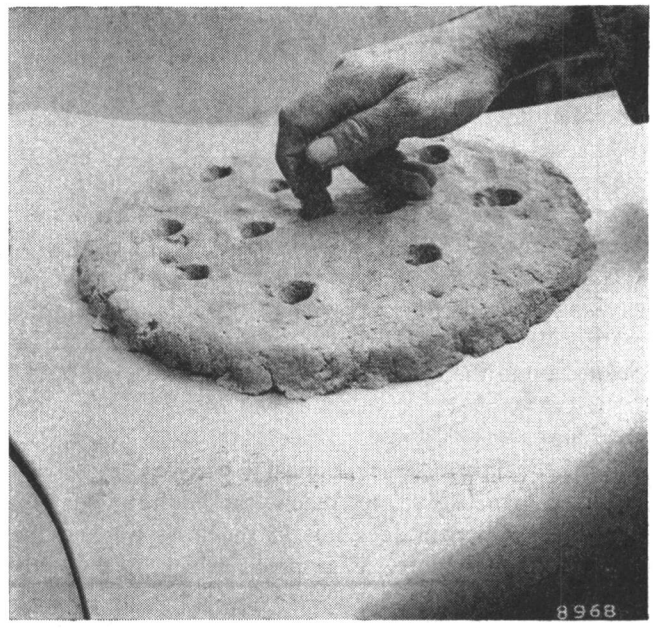


Fig. R.5
Piercing holes in the wet asbestos prior to heating

the flame of the oxy-acetylene torch is made with a finger through the centre of the asbestos. The portion of the panel which is visible is heated to a cherry-red colour and is afterwards cooled off by the wet asbestos which surrounds it. For large panels it may be necessary to repeat this operation several times at different locations over the area.

Where a panel is stretched over a fairly extensive area and produces what is known as an 'oilcan' effect the following shrinking method should be used to restore the original contour.

Mix a quantity of wet asbestos sufficient to cover the damaged area with a thickness as shown in Fig. R.5. Press the asbestos down firmly to ensure that no air is

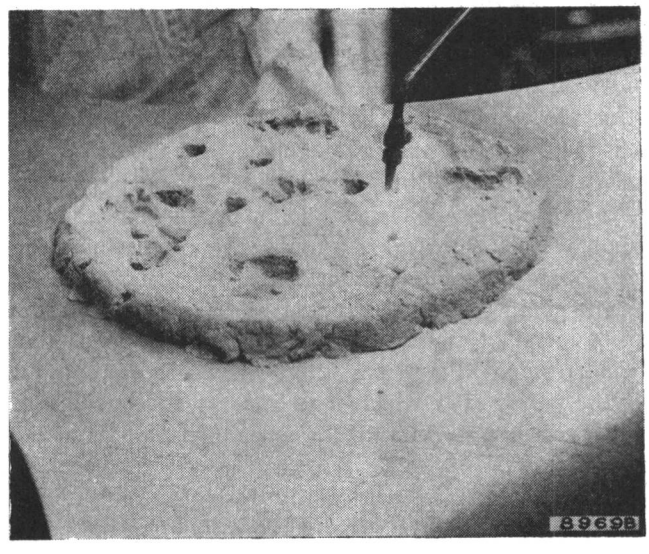


Fig. R.6
Heating a stretched panel through holes in the asbestos

trapped below, as it is important to confine the applied heat to the points of application.

With a finger pierce a series of holes in the asbestos extending to the surface of the metal. Direct the flame of the welding torch to one of the holes near the perimeter of the asbestos and heat the metal to cherry red, remove the torch, and immediately press the surrounding asbestos into the hole (Fig. R.6).

Carry out the same procedure with the remaining holes, working around the asbestos and inwards towards the centre. When the asbestos is removed the surface is cleaned up in the usual manner.

Patching

It is frequently more economical to patch an extensively damaged panel than to renew the entire assembly. This type of repair does not in the least weaken the surrounding structure, as a patch which is correctly

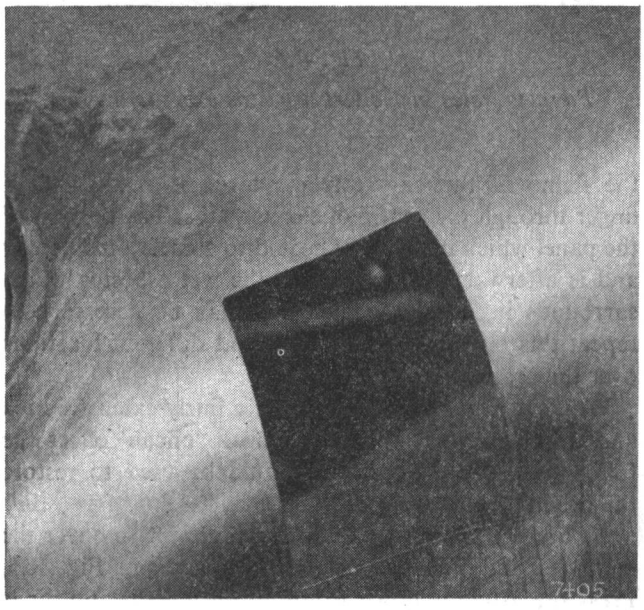


Fig. R.7
A damaged panel with piece removed for patching

gas-welded in position is equal in strength to the original structure. A patch can be introduced so efficiently that it is impossible to trace its presence.

The damaged portion of the panel should be cut out with a cold chisel or, if possible, by means of a hacksaw. The edges of the opening should then be filed until an even contour is obtained (Fig. R.7).

The patch to be fitted should preferably be cut from sheet metal of similar gauge and specification to that being repaired. First, it is rough-shaped to the contour of the panel, after which it is fitted to the opening to allow a clearance on all sides equal to the gauge of the metal.

In all probability, particularly during welding operations, difficulty will be experienced in holding the patch in place. This can be overcome satisfactorily by welding one or two short pieces of welding wire to act as convenient handles.

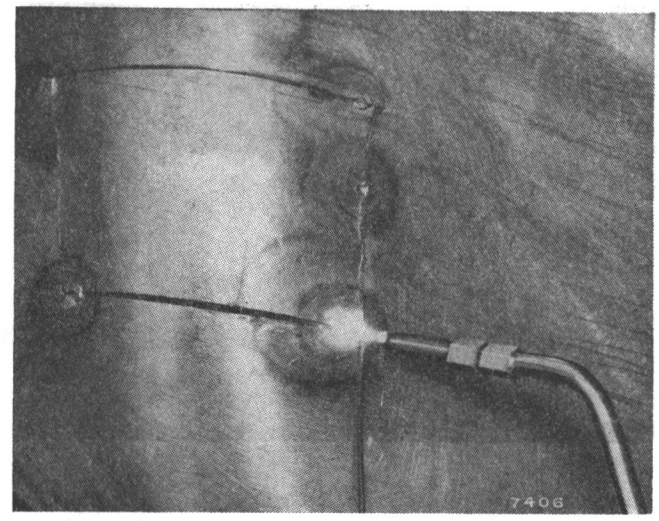


Fig. R.8
The formed patch held in position by gas-weld tacks

The patch is now fastened at intervals of 2 to 3 in. (51 to 76 mm.) to the panel by means of gas-weld tacks (Fig. R.8). During the tacking operation it should be reshaped to the panel to ensure that the contour is correct.

To prevent expansion and possible buckling of the surrounding panel during the welding operation a liberal quantity of wet asbestos must be placed on the panel round the patch, approximately $\frac{1}{4}$ in. (6 mm.) away from the joint (Fig. R.9). The joint is now gas-welded between the tacks, whilst precautions are taken to keep the patch to the correct contour by using a suitable dolly block and bumping hammer. On completion, any excrescences in the welding are removed by filing and,

Fig. R.9
Surround the joint with wet asbestos to prevent buckling during welding

after straightening with the dolly block and bumping hammer, the patching is finally finished by tinning and solder-filling as described on pages R.8 and R.9.

Patch forming

Where it is necessary to 'form' a patch from the flat sheet to any particular contour a wooden or lead raising block is generally employed. The raising block should have several elliptical depressions of varying depths and diameters.

The patch is placed over the selected depression and is raised by hammering with the ball-peen end of a hammer, starting from the outer edges and gradually working towards the centre. A mistake frequently made is to strike too hard whilst raising the centre, with the result that the curve is of greater depth than that required.

Repair of beadings and mouldings

Where difficulty is experienced in straightening or renewing a beading, moulding, or corner the original contour may be obtained by careful tinning and filling with plumber's solder. The finished work will be equal in appearance and equal in strength, whilst the substitution of soldering for straightening, or renewing, will save the necessity for removing inside trimmings, etc.

Filing

It should be clearly understood that in every case filing must be reduced to a minimum owing to the thinness of the material. Wrinkles or ridges should be removed by the spoon or dolly block, as explained on page R.2, and finished finally by tinning and solder-filling.

Replacing panels

In cases of extreme damage it will be found more economical to remove the damaged portions and replace them with new panels which are obtainable from BMC Service Ltd.

Owing to the fact that damage is usually localized, it will only infrequently be found necessary to remove a complete panel or unit. In the great majority of cases the damaged portion can be removed and a corresponding part cut from a replacement unit and located in position by gas-welding.

Section R.2

WELDING METHODS

Spot-welds

This form of welding is used extensively throughout the assembly of the mono-construction body.

The unit to be joined are pressed together between two copper electrodes through which an electric current of low voltage and high amperage is passed. The resistance of the steel to the electric current raises the metal to welding temperature and the pressure between the electrodes produces complete fusion. The resulting joint is as strong as the surrounding structure, and a correctly made spot-weld will not break or become loose by vibration.

Spot-welds cannot be broken satisfactorily by inserting a cold chisel or lever between the two panels. Each weld must be carefully drilled in the centre, using a drill approximately $\frac{3}{16}$ in. (4·76 mm.) in diameter. There is no necessity to drill through both panels as it is sufficient if the point of the drill merely penetrates the second panel. The weld is finally broken by inserting a thin, sharp, cold chisel between the joint and tapping it lightly with a hammer.

On panels where the spot-welds are covered by paint it is necessary to use a suitable paint remover to clean the paint from the joints. The spot-welds will easily be located by the discoloration of the metal. Reference to the body build-up illustrations will facilitate tracing the various joints.

Gas-welds

A gas-weld may be broken either by cutting with a hacksaw or, alternatively, with a sharp cold chisel. Place a suitable support at the back of the panel to act as an anvil whenever possible.

Lap-welds

Most lap-welds used in the mono-construction body are hidden from view by solder-filling. Reference should be made to the illustrations showing the build-up of the body in order to obtain the location of the various lap joints. This will enable the operator to direct the flame of the oxy-acetylene blowpipe onto the joint so that the solder filling can be melted and removed by the use of a duster. A lap-weld is broken by drilling out the spot-welds as previously explained.

Butt-welds

A butt-weld can be broken by the use of a hammer and chisel, the blows being directed against the panel which is to be renewed. If this method does not quickly break the weld heat applied from the oxy-acetylene torch will soften the fused edges, thus assisting the operation. Alternatively, the joint may be cut by a hacksaw.

Remaking welds

The special section of this Manual devoted to welding should be studied carefully before any attempt is made to re-weld a joint on the body by an operator who has not had the necessary experience in this class of work.

When a joint is remade it is necessary, prior to painting, to clean the surface of the weld. During this operation, as previously mentioned, care should be taken to see that the structure is not unnecessarily weakened by excessive grinding or filing. It is preferable to hammer the joint so that it lies slightly lower than the surrounding metal and to flow solder into the depression. No amount of filing on the surface of the solder can reduce the strength of the joint below (see Section R.4).

When placing a new panel in position it should be joined where possible by gas-welding through the holes drilled in breaking the original spot-welds. During the

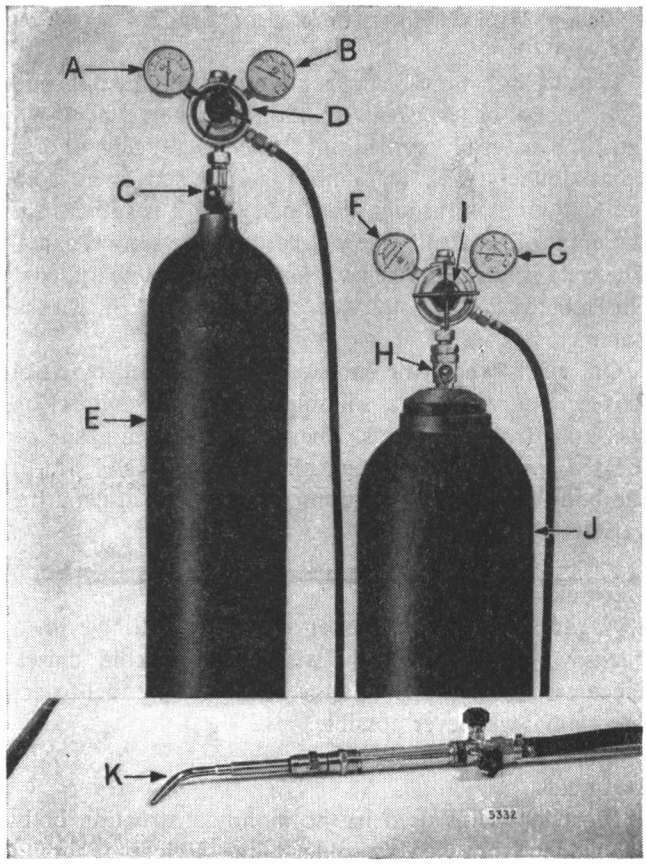


Fig. R.10

High-pressure oxy-acetylene welding outfit

A. Outlet pressure gauge (O).
B. Cylinder contents gauge (O).
C. Valve.
D. Pressure regulating screw.
E. Oxygen cylinder (BLACK).
F. Outer pressure gauge (A).
G. Cylinder contents gauge (A)
H. Valve.
I. Pressure regulating screw.
J. Acetylene cylinder (MAROON).
K. Blowpipe interchangeable nozzles.

welding operations a liberal heap of wet asbestos should be placed over the surrounding panels to prevent buckling and distortion due to heat.

Section R.3

WELDING TECHNIQUE

The following apply to equipment supplied by the British Oxygen Co. Ltd., although they also apply, in the main, to other similar equipment.

Welding equipment

High-pressure oxy-acetylene welding equipment using dissolved acetylene is recommended. This consists of:

(1) Supply of acetylene in cylinders.
(2) Supply of oxygen in cylinders.
(3) Blowpipe with necessary nozzles.
(4) Acetylene pressure regulator.
(5) Oxygen pressure regulator.
(6) Two lengths of rubber-canvas hose.
(7) Set of spanners and spindle key.
(8) Welding goggles and spark lighter.
(9) Welding rods.
(10) Welding fluxes.
(11) Trolley for accommodating complete equipment and cylinders.

Assembly

(1) Stand both cylinders vertically on the ground or on a trolley. Oxygen cylinders are painted BLACK. Acetylene cylinders are painted MAROON. **Never** attempt to interfere with the colour of cylinders or to repaint them.
(2) See that jointing surfaces in cylinder valves and regulators are free from oil or grease.
(3) Open the valve on the oxygen cylinder momentarily in order to dislodge dirt or obstruction in the cylinder valve, then close.
(4) Screw the oxygen regulator (painted BLACK) into the oxygen cylinder valve. The oxygen cylinder valve outlet and oxygen regulator connection have **right-hand** screw threads.
(5) Screw the acetylene regulator (painted MAROON) into the acetylene cylinder valve. The acetylene cylinder valve outlet and acetylene regulator connection have **left-hand** screw threads.
(6) Tighten the regulator in the cylinder valve. Do not use excessive force, but make certain that the joints are gastight.
(7) Connect the hose (acetylene RED, oxygen BLACK) to the screwed outlets of the regulators by means of the screwed connections secured in the ends of the hose. Blow the hose through before attaching to the regulator or blowpipe in order to remove dust or dirt and to remove chalk when the hose is new.
(8) Connect the other end of the hose, that fitted with a hose protector, to the blowpipe—the acetylene

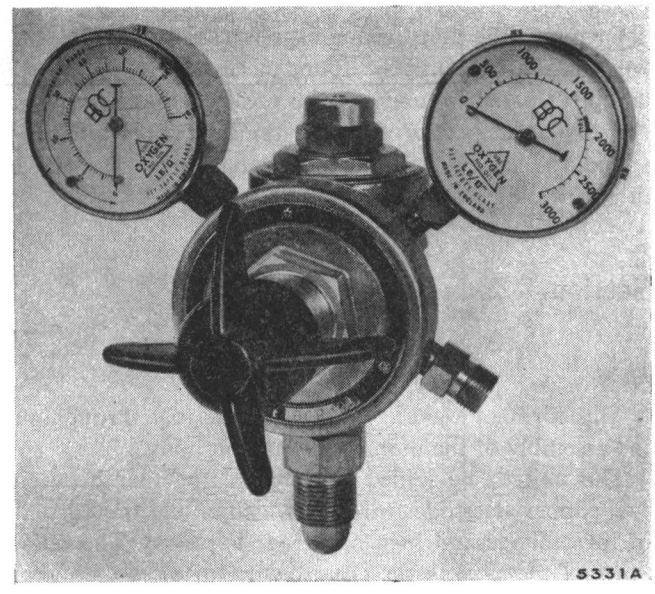


Fig. R.11

Type B.O.R.12A two-stage oxygen regulator

WELDING

HIGH-PRESSURE BLOWPIPES

Nozzle Sizes, Working Pressures, and Gas Consumptions for Various Metal Thicknesses

M.S. plate thickness		*Nozzle size*	*Regulator pressures, oxygen and acetylene Saffire equipment*		*Approximate consumption of each gas*	
in.	*mm. (approx.)*		*lb./sq. in.*	*kg./cm.²*	*cu. ft./hr.*	*m.³/hr.*
$\frac{1}{32}$	·8	1	2	·14	1	·028
$\frac{3}{64}$	1·2	2	2	·14	2	·056
$\frac{1}{16}$	1·6	3	2	·14	3	·084
$\frac{3}{32}$	2·4	5	2	·14	5	·140
$\frac{1}{8}$	3·2	7	2	·14	7	·196
$\frac{5}{32}$	4·0	10	3	·21	10	·283
$\frac{3}{16}$	4·8	13	3	·21	13	·367
$\frac{1}{4}$	6·4	18	3	·21	18	·504
$\frac{5}{16}$	8·0	25	4	·28	25	·700

hose to the connection marked 'A', the oxygen to the connection marked 'O'. Keep the blowpipe control valves closed. (A high- or low-pressure blowpipe can be used with the dissolved acetylene. If a low-pressure blowpipe is used the acetylene pressure should never exceed 2 lb./sq. in. [·14 kg./cm.²].)

(9) Fix the appropriate nozzle to the blowpipe. (See the table above.)

(10) Open the cylinder valves very slowly by means of the cylinder key. Do not open suddenly, or there may be serious damage to the regulator and the possibility of an accident. Open the cylinder valve spindle one turn only.

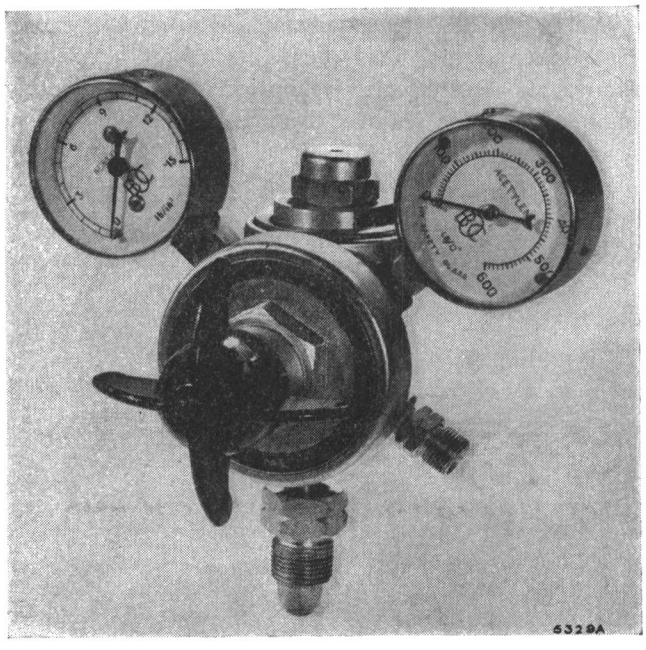


Fig. R.12

Type B.A.R.9 two-stage acetylene regulator

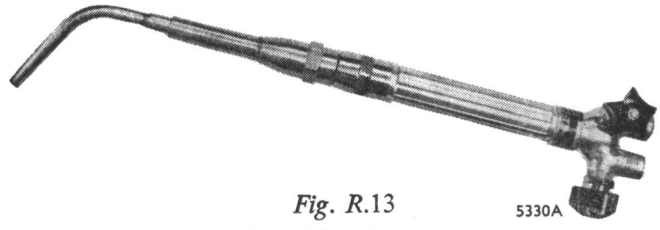


Fig. R.13

The welding blowpipe

(11) Set the regulators at the correct working pressures. (See the table).

(12) Open the acetylene control valve on the blowpipe, wait a few seconds until air is blown out and pure acetylene is coming from the blowpipe nozzle, then light, preferably by means of a spark lighter, type S.L.1.

(13) Reduce or increase the acetylene supply by the blowpipe valve until the flame just ceases to smoke.

(14) Turn on the oxygen by the blowpipe control valve until the white inner cone in the flame is sharply defined, with the merest trace of an acetylene haze.

The blowpipe is now adjusted for welding steel, and work may be commenced.

The size of nozzle given for a particular thickness of steel is for general guidance only and will vary according to the skill of the welder, mass of metal, etc. The capacity of each nozzle overlaps the capacities of those next in size to it. The values given are for downhand butt-welds in mild steel. For other techniques nozzle size and pressure may have to be varied slightly, e.g. for copper select a larger nozzle, for aluminium a smaller nozzle.

On thin-gauge steel up to and including $\frac{1}{16}$ in. (1·59 mm.) thickness tacks should be slightly closer together—say, 1 to $1\frac{1}{2}$ in. (25 to 38 mm.) apart—to keep the edges in alignment and minimize distortion.

For the same reason patches should, wherever possible, be oval or circular. Before welding, these should be slightly 'dished' below the level of the surface to be

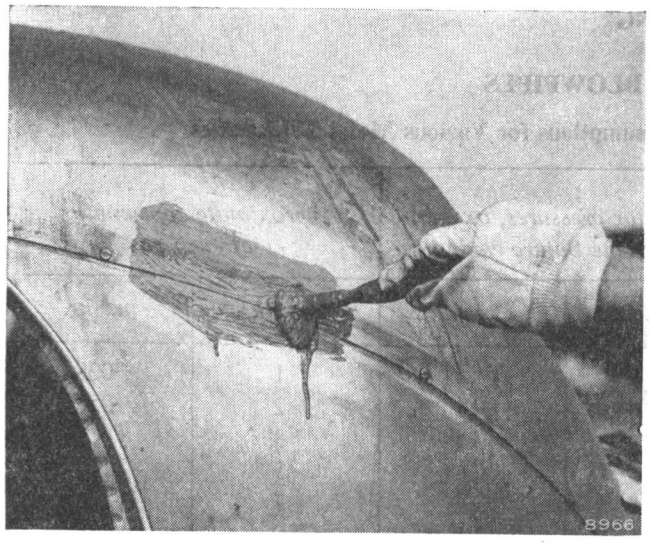


Fig. R.14
Painting the hollow area with flux

patched, since welding—even by the correct 'sequence'—will cause them to expand and rise.

Do not light the blowpipe until everything else has been prepared for welding in accordance with the instructions given above. On completion of the job proceed as follows:

(1) Turn off the acetylene first by the blowpipe control valve, and then the oxygen.
(2) Close the cylinder valves.
(3) Open the blowpipe valves one at a time to release the pressure in the hose—open the oxygen valve and shut it, open the acetylene valve and shut it.
(4) Unscrew the pressure regulating screws on the oxygen and acetylene regulators.
(5) In the case of **backfire** turn off the **oxygen** first.

Section R.4

TORCH-SOLDERING

Torch-soldering is the method employed to obtain the desired contour of a panel without weakening the structure and with the minimum amount of straightening, filing, and polishing.

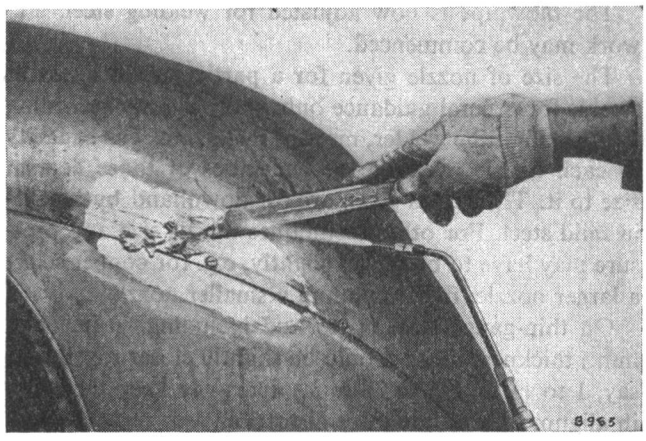


Fig. R.15
Applying the solder

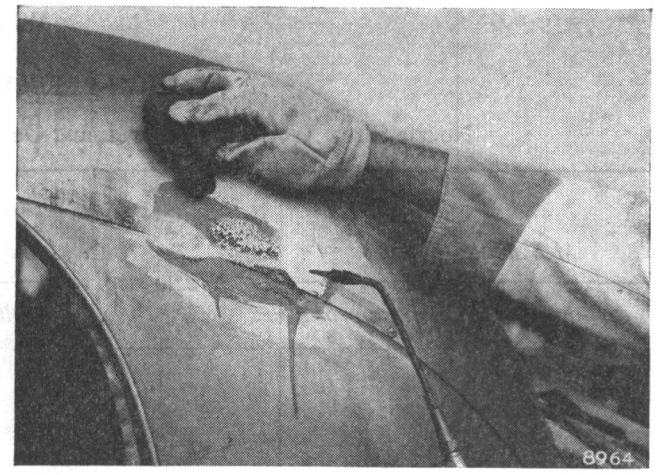


Fig. R.16
Tinning by heating the flux-painted area

The solder used is an alloy of lead and tin. Lead melts at a temperature of 327° C. (621° F.) and tin at 232° C. (450° F.). Alloys of the two metals change from a solid to a liquid state over this range of temperature within which they are in a plastic condition. The alloys used for torch-soldering are known as tinman's solder (which contains 60 per cent. lead and 40 per cent. tin) and plumber's solder (which contains 70 per cent. lead and 30 per cent. tin). Tinman's solder, as a result of its higher tin content, alloys more readily with the surface of the sheet steel and is applied as a 'base' to which the plumber's solder adheres firmly. Plumber's solder remains plastic over a wide range of temperature (from 265 to 181° C. [509 to 358° F.]), and within this range can be moulded to any desired shape. For this reason it is used to obtain the required contours.

Where it is desired to build up a contour with solder the surface of the steel must first of all be cleaned thoroughly. Rust, scale, welding oxide, or any other impurity must be removed by means of a wire brush,

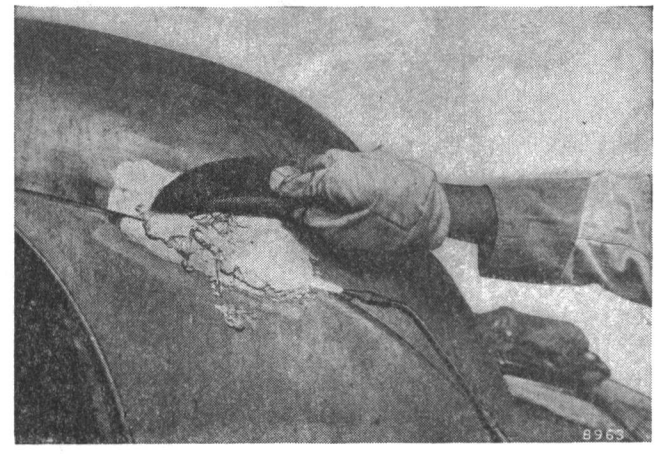


Fig. R.17
Spreading the solder

file, and emery-cloth. A polishing wheel, if available, is useful for this operation.

The surface of the metal is heated gently with a blow-lamp or gas-torch, and soldering flux applied with a brush (see Fig. R.14).

The flux will melt and act upon the heated surface so that when tinman's solder is applied and rubbed with a wad of hemp the metal will become evenly coated with a thin layer of solder, or 'tinned' (Fig. R.16). The secret of successful torch-soldering lies in the thoroughness with which the tinning operation is carried out as it is the foundation on which the plumber's solder is to be built up.

A second application of flux should be made and gently heated by means of the torch. When wiped by the wad of hemp the entire surface of the metal should have a spotlessly clean and bright appearance.

Plumber's solder is now melted onto the surface (Fig. R.15) and maintained by careful use of the torch in the plastic condition whilst it is moulded to the desired contour with a hardwood paddle coated with palm oil (Fig. R.17). During the moulding operation frequent immersion of the paddle in palm oil assists in the manipulation of the solder. If palm oil is not available boiled linseed, lard, or machine oil will be found satisfactory.

The final contour is obtained by filing or, if available, by the use of a polishing wheel. If the work is carefully carried out it should be impossible to trace the presence of the filing.

Section R.5

WINDSHIELD GLASS

Removing

Lift the windshield wiper arms clear of the glass.

Prise up the end of the locking filler and carefully pull it from the channel in the surround rubber.

Press the glass from inside the car, commencing at a corner, and ease the surround rubber from the metal edge of the body aperture.

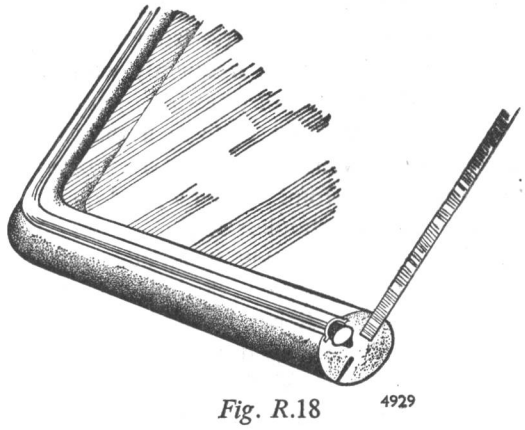


Fig. R.18

The section shows the outside finisher strip and rubber filler positioned in the seal and the seal pressed onto the glass

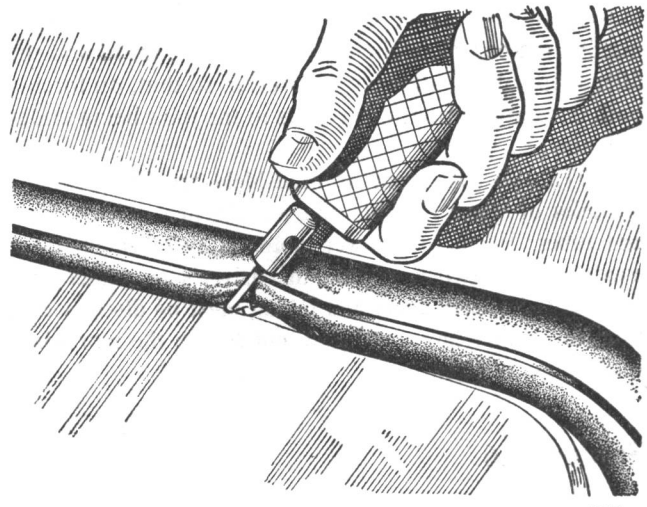


Fig. R.19

Use special tool 18G 468 to ease the channel lip over the windshield glass

Refitting

If the glass has been broken, remove any pieces which remain in the channel. Examine the rubber, and use a new rubber should there be any signs of damage or deterioration.

Fit the surround rubber to the body aperture and lubricate the 'glass' channel with a soap and water solution. Place the windshield glass into the lower channel of the rubber surround and commence at the corner to lift the lip of the rubber over the glass, using special tool 18G 468. Use the short peg on the handle of the installation tool for this purpose.

Apply soap-and-water solution to the locking filler strip channel to assist in fitting the strip.

Using the installation tool and eye, thread the locking filler strip through the handle and eye. Insert the tool into the filler strip channel, hold the end of the filler in position with the thumb, and commence to draw the tool along the channel, feeding the filler through the handle and eye into the channel. A slight agitating side-to-side

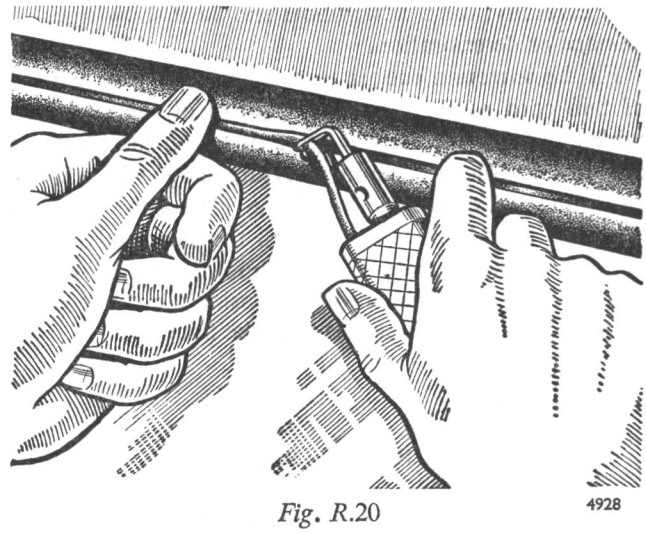


Fig. R.20

The use of the glazing tool and eye to thread the locking filler strip into the rubber channel

movement will assist in rounding the corners. After making the complete circuit, the tool is removed and the filler strip cut off, allowing an overlap so that, on forcing both ends in position, this results in the joint being under pressure.

NOTE.—In the event of windshield breakage, minute particles of glass fall into the windshield demister ducts and tubes. When the blower motor is switched on these particles are discharged into the driver's or passenger's face. The demister ducts and tubing must be disconnected from the heater box and blown out before the new windshield glass is fitted.

Section R.6

BACK-LIGHT GLASS

To remove and refit the back-light glass follow the instructions given in Section R.5.

Section R.7

DOOR GLASSES

To remove the sliding door glasses withdraw the self-tapping screws securing the bottom channel to the top of the door panel. With the screws removed both the sliding glasses and the channel can be lifted away.

Section R.8

QUARTER-LIGHT GLASSES

Removing

Support the glass on the outside with the palm of the hand and strike it sharply with the flat of the free hand at the top of the glass from the inside of the car. The glass and rubber will be displaced sufficiently at the top edge to allow removal.

Refitting

If the glass has been broken, remove any pieces that remain in the channel. Examine the surround rubber very carefully; use a new rubber should it show signs of damage or deterioration.

Fit the surround rubber to the glass and pass a piece of thin cord round the outer channel of the surround rubber, leaving the ends hanging down on the inside of the glass. Lubricate the body aperture flange with a soap-and-water solution, and offer the glass into position from the outside of the car. With the surround rubber pressed lightly against the aperture flange, a second operator must pull the cord from inside the car to draw the lip of the rubber channel over the flnage.

Section R.9

DOOR LOCKS

Removing

Withdraw the three screws securing the lock to the inner door panel and the retaining screw from the end of the locking handle spindle.

In order to remove the door handle release the inner control operating lever by slackening the screw clamping the lever to the handle spindle. Both the handle and the escutcheon can then be withdrawn.

Refitting

When refitting make certain that the inner control cable operating lever is fitted upright to ensure lock operation from inside the car when the cable is pulled or pushed downwards. Tighten up the operating lever clamping screws.

Striker plate

Adjustment of the striker plate position is usually only necessary when the striker itself has been replaced. Do not interfere with its setting otherwise. Repositioning is carried out by a process of trial and error, proved by checking the closing action of the door and its position when closed.

Section R.10

LUGGAGE COMPARTMENT LOCK

To remove the luggage compartment lock extract the two set screws and two self-tapping screws securing the lock to the lid. Remove the two nuts from the handle retaining studs to release the handle and locking mechanism.

Section R.11

BUMPERS

Both the front and rear bumpers can be removed when the six nuts and plain and spring washers securing each bumper to the body are removed from the mounting screws.

Section R.12

BODYWORK AND UPHOLSTERY

It is advisable to wash the coachwork of the car with an abundant quantity of water to remove all traces of dust, mud, and traffic film. Polish the paintwork frequently with a good-quality car polish free from abrasive.

Wash the chromium parts frequently with soap and warm water, and when the dirt has been removed polish the surface with a clean dry cloth or a chamois-leather until bright. Metal polishes, or abrasives of any sort, must not be used on chromium, but a good-quality metal polish may be used on stainless steel.

When cleaning windshields it is advisable to use methylated spirits (denatured alcohol) to remove tar spots and other stains. It has been found that the use of some silicon- and wax-based polishes for this purpose can be detrimental to the windshield wiper blades.

The upholstery of the car should be cleaned periodically by wiping over with a damp cloth; a little neutral soap may be used if necessary. Neither detergents, caustic soaps, nor spirits of any kind must be used.

Section R.13

HEATER

Operation

The heater when fitted is controlled by a rheostat switch located on the right-hand side of the control panel. The first few degrees of movement in a clockwise direction will bring the air-circulating fan into operation at its maximum speed; further movement in this direction will gradually reduce the speed of the fan to regulate the heating of the car interior.

A tap on the rear of the engine is intended to be closed in hot weather or when heating is not required. The fan can then be used to circulate air in the interior of the car, although it is primarily intended for the circulation of warmed air.

Removing

Disconnect the battery. Drain the water from the cooling system. Disconnect the snap connectors on the two leads from the heater motor located beneath the parcel shelf. Slacken the clips securing the demister tubes and the inlet and outlet hoses to the matrix. Take the necessary precautions to prevent any coolant remaining in the heater matrix and the hoses from dripping or splashing the floor covering and upholstery before pulling the hoses from their connectors on the heater.

The inlet and outlet water hoses can be withdrawn from the car when the clips are slackened and removed.

Refitting

Refit the heater and connect up the inlet and outlet water hoses, and the demister tubes.

Reconnect the leads to the heater motor. Make certain that both the drain taps are turned off, open up the heater tap on the rear of the engine, and refill the cooling system. Reconnect the battery and run the engine at a fast tick-over and switch on the heater. If the water return hose does not warm up in a few minutes there may be an air lock in the system. To clear the air lock switch off the engine and disconnect the return hose at its connection to the radiator bottom hose. Extend the return hose with a length of hose long enough to enable the coolant to be returned via the radiator filler aperture, and plug the return connection on the radiator bottom hose. Start the engine and note the water flow into the radiator aperture. When the flow becomes smooth and bubble-free switch off the engine and remake the connection to the radiator bottom hose and tighten up as quickly as possible.

Section R.14

REAR DOORS (VAN)

Removing

Open the doors and disconnect the door stop stays by removing the nut washer and bolt in the end of each stay. Bend down the tab washer on each door hinge, support the door, and remove the nut, tab washer, spring, hinge bolt, and the spherical bush from each pair of door hinges in turn.

Refitting

Refitting is a reversal of the removal sequence. After refitting the doors ensure that the door lock engages correctly and that a positive lock is obtained at the end of each door lock stay.

Windows

The door windows may be removed and replaced as described in Section R.8.

Door lock

To remove the door lock unscrew the four screws that secure the lock to the door and ease the lock and the stays from the stay guides. Unscrew the two nuts securing the handle to the door and remove the handle.

Replacement is a reversal of this procedure.

Section R.15

HEATER FITTING INSTRUCTIONS
(Recirculatory Type)

Disconnect the battery, drain the cooling system, and remove the parcel shelf floor lining and the curved bulkhead lining; the curved bulkhead lining is in two halves and is retained at each end by a self-tapping screw.

Check the position of the fixing holes in the shelf in relation to the fixing points on the heater, and, if necessary, reposition the holes in the shelf to suit the heater (earlier cars were drilled for three-point fixing only).

Heater and air hoses

Secure the heater firmly to the under side of the shelf with the two nuts and the two bolts provided. Two weld nuts and two weld bolts are incorporated in the heater.

Connect the end of one air hose to the right-hand demister nozzle and the end of the other hose to the left-hand demister nozzle. Pass the free end of each hose through the appropriate hole in the parcel shelf and connect them to their respective air outlet connections on the heater. Fit the demister nozzles to the fascia panel and secure each nozzle with the two screws provided.

Water pipes

Remove the blanking plate from the cylinder head and use the existing bolts and washers to fit the water tap. Connect one end of the longer hose to the tap and thread the other end through the right-hand hole in the footboard and connect it to the lower heater inlet pipe.

Remove the lower radiator hose and in its place fit the hose having the moulded 'take-off' pipe. Connect one end of the remaining water hose to the 'take-off' pipe, and thread the other end of the hose through the left-hand hole in the footboard and connect it to the top heater outlet pipe.

Secure all water hoses with the hose clips provided.

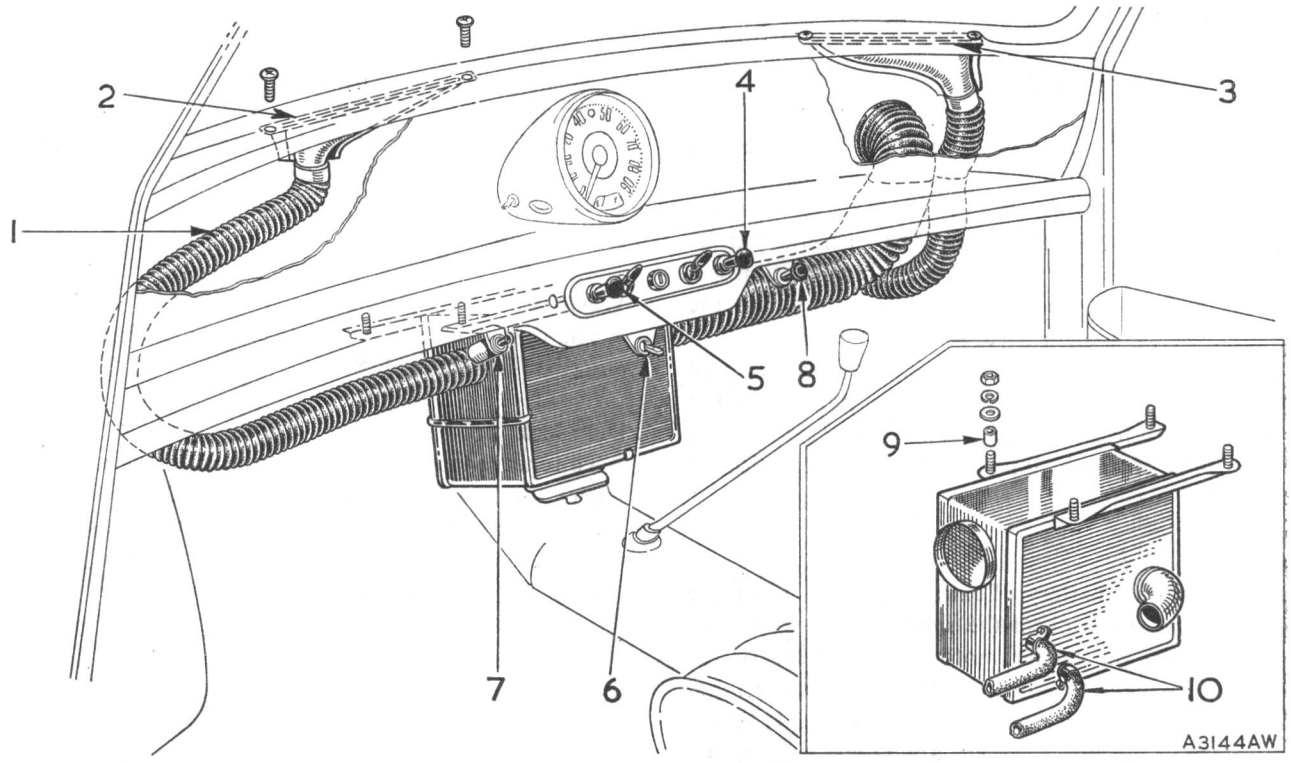


Fig. R.21

Air hoses and fittings

1. Demister hose.
2. Demister duct—L.H.
3. Demister duct—R.H.
4. Air control.
5. Heat control.
6. Blower switch.
7. Windshield washer control (repositioned).
8. Choke control (repositioned).
9. Spacers.
10. Inlet and outlet hoses.

Electrical connections

Remove the switch knob, ring nut, and the washer from the rheostat. Connect the black lead from the heater motor to the black lead emerging from the loom beneath the fascia shelf. Connect the remaining lead from the motor to its mating terminal on the switch. From the loom select the green lead with brown tracer and connect it to the remaining terminal on the switch.

Remove the blanking plug from the control fascia, fit the switch to the fascia, and secure it with the spring washer and the nut. Refit the control knob.

Section R.16

HEATER FITTING INSTRUCTIONS
(Fresh-air Type)

Introduction

The heater is fitted below the parcel shelf and is supplied with fresh air from an intake situated behind the front grille. A blower is incorporated in the air circuit and is fitted on the right-hand wing valance under the bonnet.

Before commencing the installation, drain the cooling system, disconnect the battery earth lead, and remove the curved bulkhead lining and parcel shelf floor lining. The bulkhead lining is held in position at each extreme outside end by a self-tapping screw and is in two halves. The bodies of some early cars were not modified to readily accept the fresh-air type of heater. The additional operations necessary to convert these bodies are given at the end of the section under the heading **'Early models'.**

These bodies can be readily identified from under the bonnet by the absence of a large-diameter hole in the right-hand side of the vertical surface of the parcel shelf bulkhead (see Fig. R.23) and a corresponding hole in the parcel shelf floor inside the car.

Some bodies may have these two holes and yet may require certain other holes for fitting such things as switches, controls, etc. In these cases reference should be made to the appropriate section under **'Early models'.**

Air hoses and blower motor

From inside the engine compartment remove the four self-tapping screws retaining the blanking plate on the right-hand side of the bulkhead panel and discard the plate.

Using a suitable adhesive, stick the large-diameter rubber grommet supplied in position in the hole.

Fit the right- and left-hand demister ducts below the outlets in the top fascia rail and secure with the four chromium-plated screws supplied.

Pass the small-diameter air hoses through the holes in each extreme corner of the parcel shelf floor and push each hose onto its demister duct. The longest hose should be fitted to the right-hand demister duct.

Remove the self-tapping screws retaining the front grille and detach the grille.

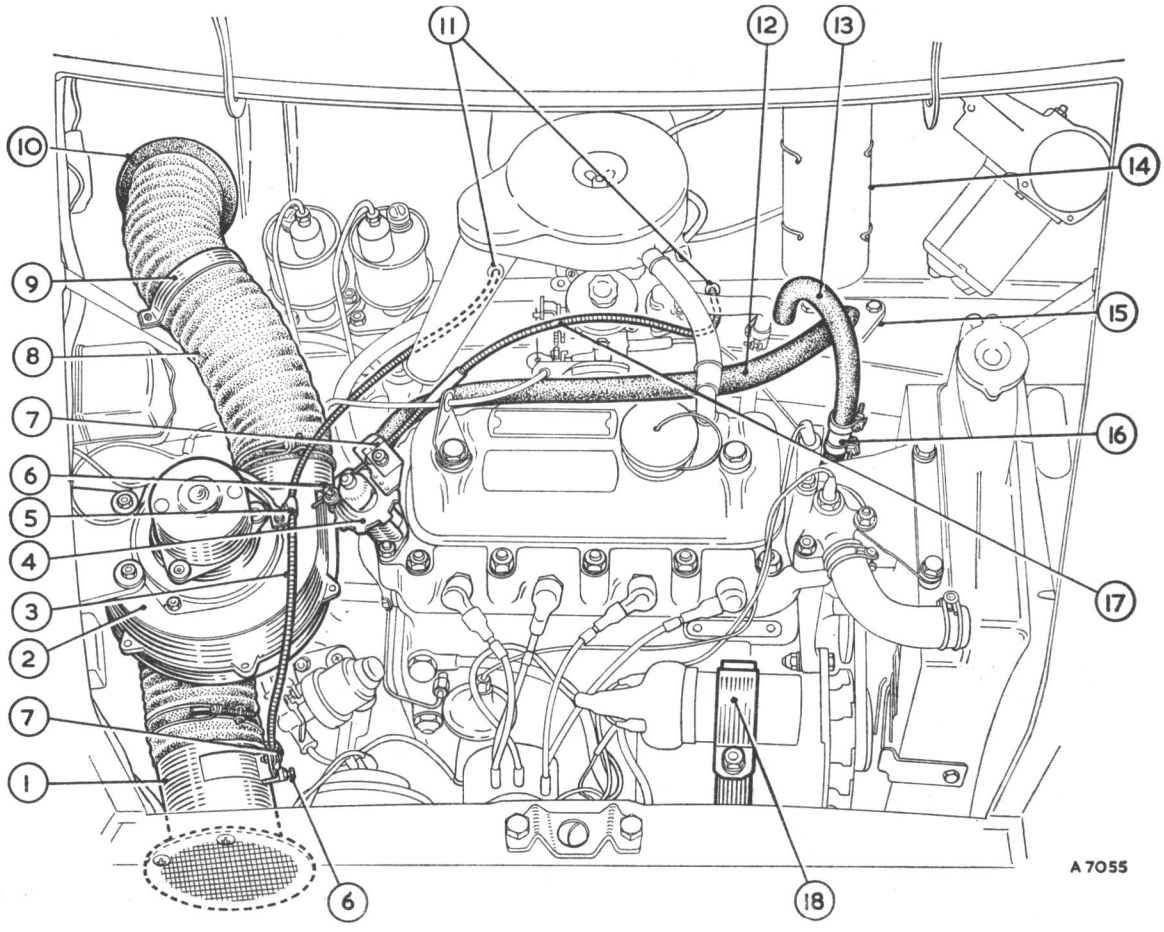


Fig. R.22

The fresh-air heater under-bonnet layout (R.H.D.)

1. Air intake assembly.
2. Blower motor.
3. Air control cable.
4. Heater control tap.
5. Air control cable support bracket.
6. Cable clamp screw.
7. Outer cable abutment.
8. Air delivery hose.
9. Hose support clip.
10. Delivery hose grommet.
11. Control cable grommets.
12. Water feed hose.
13. Water return hose.
14. Windshield washer bottle.
15. Blanking plate.
16. Copper connector.
17. Heat control cable.
18. Coil bracket.

Fit the coil mounting bracket supplied to the body of the dynamo with the studs facing upwards.

Remove the coil and bracket from the flywheel housing and fit to the bracket on the dynamo with nuts, spring washers, and plain washers. Replace the two original mounting screws in the flywheel housing, using the special washers provided. Position the air intake assembly on the rear face of the grille surround and secure in position with the two special flat-ended, self-tapping screws.

Attach the shorter of the two large-diameter air hoses to the blower motor intake and secure with the clip provided. Fit the other end of the hose to the air intake tube assembly and secure with a clip. Clean off the paint around the forward top blower mounting hole in the wing valance to provide an electrical contact and fit the blower motor lead with the terminal tag over the appropriate blower mounting stud.

Position the blower motor on the wing valance and secure in position from under the wing with the nuts, spring washers, and plain washers supplied.

Fit the coil mounting bracket clamping bolt, ensure that the coil does not foul any engine component, and tighten the clamp bolt.

Refit the front grille.

Windscreen washer bottle

If fitted to the right-hand wing valance, reposition on the vertical bulkhead at the opposite side to the clutch and brake master cylinders approximately 3 in. (76·2 mm.) inside the bonnet hinge.

Water connections

Remove and discard the blanking plate from the rear of the cylinder head and fit the heater control tap, using a new gasket, and the existing washers and nuts. Remove the bottom water hose and replace with the special hose provided, using the existing hose clips. Fit the short copper connecting tube supplied to the hose extension and secure in position with one of the clips provided.

Remove the blanking plate from the top face of the dash panel cross-member at the opposite side to the clutch and brake master cylinders and fit the special plate provided, using the existing fixing screws and nuts and

sealing washer. Pierce the sealing washer to allow the water hoses to pass through the two holes in the blanking plate.

From the engine compartment pass the elbow end of the longest water hose (R.H.D.) or the shorter hose (L.H.D.) through the outside hole in the plate. Lubricate the hose with soft soap to facilitate this operation. Attach the other end of the hose to the heater control tap and secure with a hose clip.

Pass the elbow end of the shorter hose (R.H.D.) or longer hose (L.H.D.) through the inside hole in the plate, connect the other end to the copper connecting tube in the bottom radiator water hose, and secure with a clip.

Controls

Disconnect the choke control at the carburetter. From inside the vehicle remove the choke control, lighting switch, ignition switch, and windshield wiper switch from the control panel. Remove the screw retaining the control panel at either end, detach the panel, and fit the new control panel supplied, using the existing screws. Ensure that the flat on the centre hole in the panel faces towards the right-hand side and refit the switches in their original positions. Remove the two rubber blanking plugs from the vertical bulkhead just below the bulkhead to parcel shelf seam. These are located one either side of the carburetter. Fit the two small grommets supplied to these holes. Fit the heat control cable to the extreme left-hand hole and the air control to the extreme right-hand hole in the control panel, threading the cables through the corresponding grommet in the bulkhead. Slide the two rubber sleeves over the heat control cable from under the bonnet so that one is in the area of the carburetter float-chamber and the other near the oil filler, thus preventing metal-to-metal contact at these points.

Fit a cable clamp and screw to the forked end of the heater control tap lever and pass the inner control cable through the clamp. Secure the end of the outer cable in the abutment clamp on the control tap. Rotate the lever in an anti-clockwise direction to the limit of its travel, ensure that the heat control knob is pushed fully in, and tighten the inner cable clamp screw.

Pass the air control cable support bracket over the outer cable and secure the bracket under the blower motor securing nut nearest to the heat control tap.

Fit a cable clamp and screw to the fork of the lever on the air intake assembly and pass the inner control cable through the clamp. Secure the end of the outer cable in the cable abutment on the intake assembly, push down the lever to its fullest extent, ensure that the air control knob is fully pushed in, and tighten the inner cable clamp screw.

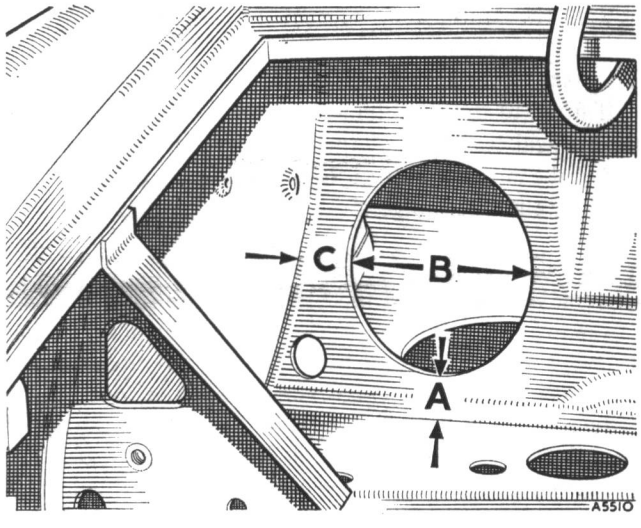


Fig. R.23

A. 1⅛ in. (31·75 mm.). B. 3⅞ in. (98·42 mm.).
C. 1⅜ in. (34·92 mm.).

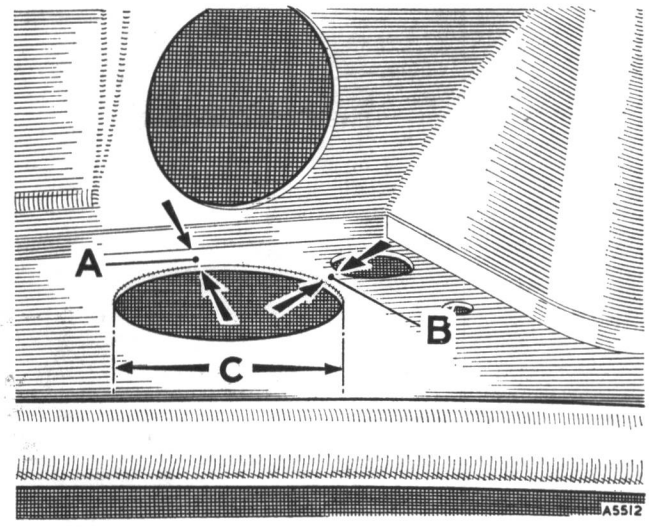


Fig. R.24

A. ¾ in. (19·05 mm.). B. ⅜ in. (9·52 mm.).
C. 3⅞ in. (98·42 mm.).

If a windshield washer is fitted the control must be transferred to the under side of the parcel shelf rail at the left-hand side of the control panel.

Attach the choke control cable bracket supplied to the under side of the parcel shelf rail at the right-hand side of the control panel (in the position previously occupied by the windshield washer control when fitted). Fit the choke control to the bracket and pass the cable through its original grommet in the bulkhead.

Reconnect the cable to the carburetter.

Fit the blower switch bracket supplied to the parcel shelf rail immediately below the ignition switch. The angle of the bracket must face towards the bulkhead and the fixing face must be on top of the parcel shelf rail. Fit and tighten the two securing screws and spring washers from the under side of the parcel shelf rail.

The switch can then be fitted to the bracket.

The Lucar connector of the green lead emerging from the loom below the parcel shelf must be connected to one terminal of the switch.

Thread the snap connector end of the extension lead supplied through the loom grommet on the extreme right-hand side of the bulkhead. Attach the Lucar

connector to the other terminal of the switch and the snap connector to the lead on the blower motor under the bonnet.

Heater box

Support the heater box below the parcel shelf and attach the two water hoses to the connections at the rear of the heater box. The hose from the heat control tap must be connected to the lower connection. Secure each hose firmly with a clip. Push the right-hand demister hose into the rubber elbow at the rear of the box.

Place the four spacers over the heater box mounting studs and pass the studs through the mounting holes in the parcel shelf floor. Secure the heater box in position with the nuts, spring washers, and plain washers provided.

From inside the engine compartment feed the remaining air hose through the hole in the parcel shelf floor. Attach one end of the hose to the intake of the heater box and the other end to the outlet of the blower motor, using the clips provided. Do not overtighten the clips.

Pass the air hose support clip over the air hose under the bonnet and secure the clip to the flange of the cross-member brace with the self-tapping screw supplied.

Fit the left-hand demister hose to the connection on the left-hand side of the heater box.

Bonnet and trimming

Replace the parcel shelf floor covering, cutting as necessary to clear the large air hose. Refit the curved bulkhead trimming and secure at the extreme ends with the original self-tapping screws.

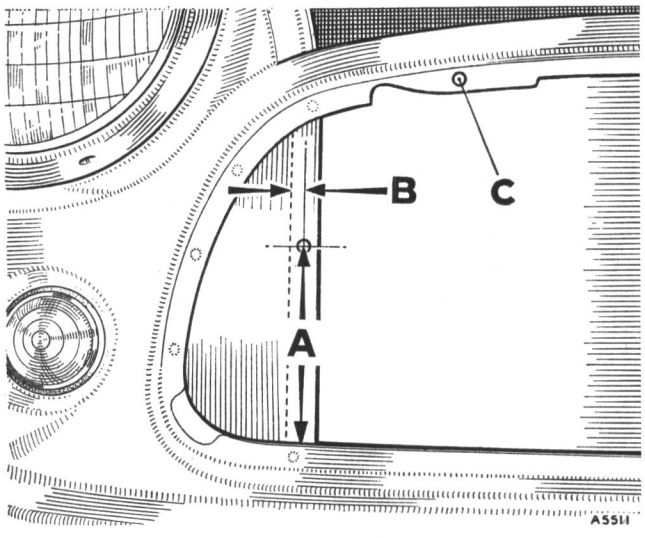


Fig. R.25

A. $3\frac{3}{4}$ in. (95·25 mm.). B. $\frac{7}{16}$ in. (11·11 mm.).
C is the appropriate position of the second fixing hole.

Replace the bonnet. The bonnet stay will foul the blower motor when closing the bonnet, and to prevent this the stay must be bent locally towards the centre-line of the car to clear the blower motor by at least $\frac{1}{4}$ in. (6·35 mm.).

Testing

Reconnect the battery earth lead, refill the cooling system, ensure the heat control knob is pushed fully in, start the engine, and run at a fast tick-over speed.

The water return hose should warm up after a few minutes. If this is not so an air lock may have formed in the heater system. To clear this, switch off the engine, disconnect the heater return hose at its connection to the bottom radiator hose, and add an extension hose to the heater return hose sufficiently long to reach the radiator filler cap. Start the engine and watch the water flow into the radiator filler from the heater hose. When

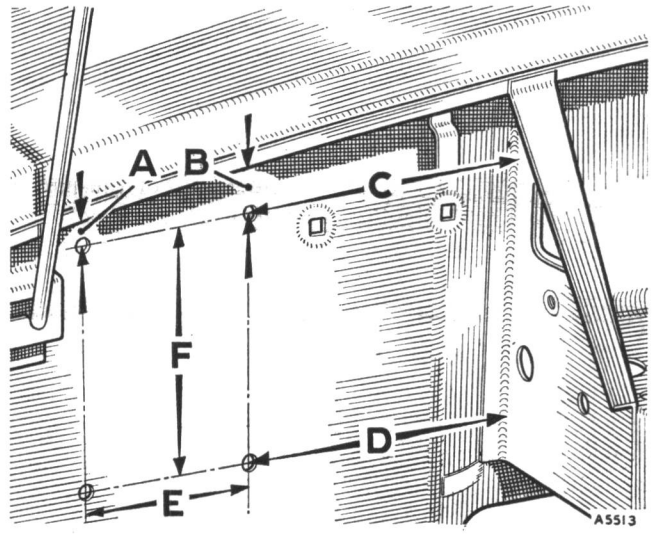


Fig. R.26

A. $1\frac{5}{8}$ in. (41·27 mm.). B. $1\frac{15}{16}$ in. (49·21 mm.).
C. 7 in. (177·8 mm.). D. $6\frac{1}{8}$ in. (155·57 mm.).
E. $3\frac{1}{16}$ in. (77·78 mm.). F. $4\frac{7}{8}$ in. (123·32 mm.).

the flow becomes smooth and free from air bubbles, switch off the engine and quickly reconnect the heater return hose to the bottom radiator hose.

Check all water connections for leaks, and re-test.

NOTE.—In freezing conditions anti-freeze MUST be used in a cooling system incorporating a heater.

Early models

Bulkhead and parcel shelf

Cut a circular flat metal template $3\frac{7}{8}$ in. (98·425 mm.) diameter and lay on the bulkhead, positioned as shown in Fig. R.23. Mark a circle around the template and cut the hole.

The hole in the parcel shelf floor is marked off and cut, using the same template, but in the position shown in Fig. R.24.

Intake tube and horn

Remove the horn and mark off and drill a hole $\frac{3}{16}$ in. (4·763 mm.) diameter as shown in Fig. R.25. Attach the intake tube assembly to the rear of the grille surround by one screw and, using the intake tube flange as a template, mark off and drill a further hole at point C (Fig. R.25). Fit the second intake tube retaining screws.

Reposition the horn approximately 3 in. (76·2 mm.) towards the centre of the vehicle.

NOTE.—Some early models had a pop-rivet fixing for the front grille. Remove the rivets and use suitable self-tapping screws to refit the grille.

Blower motor and control box

Drill four $\frac{9}{32}$ in. (7·144 mm.) holes in the wing valance as shown in Fig. R.26.

Reposition the control box as high and as close as practicable to the wiring loom and secure with the existing screws.

Control cables

Holes may have to be drilled in the engine bulkhead to accept the heat and air control cables and grommets.

From inside the car mark off and drill two $\frac{3}{8}$ in. (9·525 mm.) holes in the vertical bulkhead in direct line with the heat and air control mounting holes in the control panel.

Blower switch

Position the bracket on the under side of the parcel shelf rail below the ignition switch; using the bracket as a template mark off and drill two $\frac{3}{16}$ in. (4·763 mm.) holes.

Heater box fixing

The two forward fixing holes will already be in existence. Place the heater box in position under the parcel shelf floor and mark off the position of the two rear fixing holes. Drill two $\frac{3}{8}$ in. (9·525 mm.) holes at the marked positions.

Section R.17

WINDSHIELD WASHER FITTING INSTRUCTIONS

Fluid container bracket

(1) Position the bracket on the inside of the right-hand valance, and from the bracket mark off the two fixing holes. Drill the holes $\frac{13}{64}$ in. (5·16 mm.) diameter.

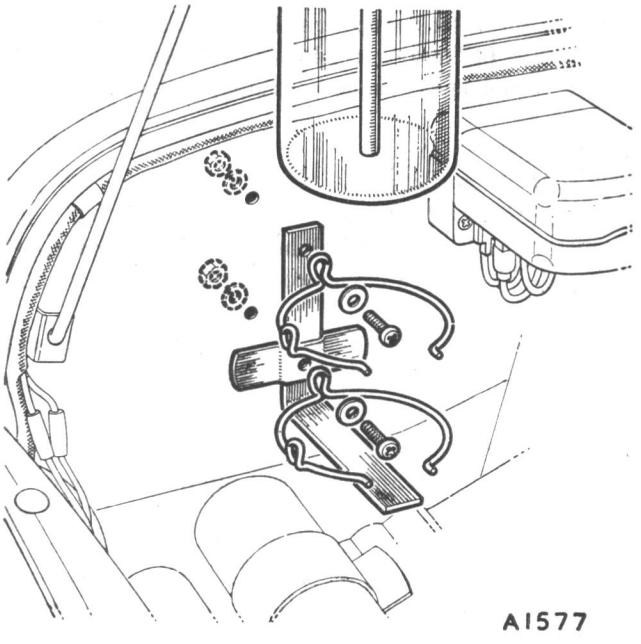


Fig. R.27
Fitting the container bracket

(2) Secure the bracket and the container retaining clip to the valance with two No. $10 \times \frac{1}{2}$ in. screws, washers, and nuts.

(3) Snap the container into the retaining clip.

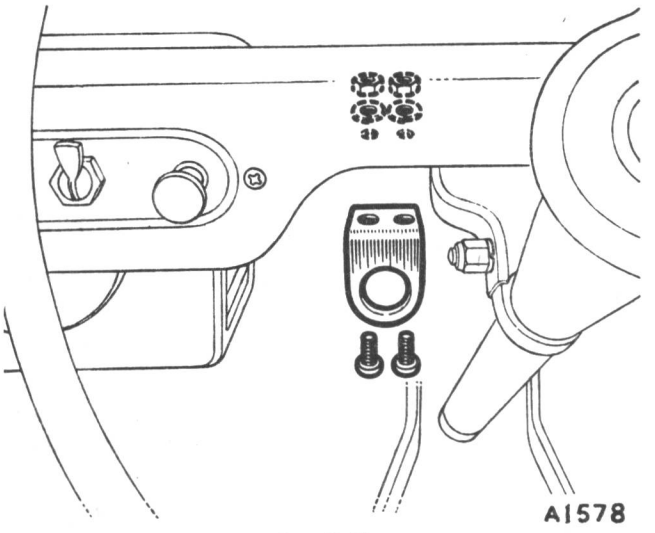


Fig. R.28
Fitting the plunger bracket

Pump assembly

(1) Remove the shelf lining and position the pump assembly bracket under the parcel shelf as shown in Fig. R.28; mark off and drill two $\frac{7}{32}$ in. (5·56 mm.) holes in the shelf.

(2) Secure the bracket to the shelf with two No. $10 \times \frac{3}{8}$ in. screws, washers, and nuts. Replace the shelf lining.

(3) Remove the outer nut and the nameplate from the pump assembly. Fit the pump to the bracket, replace the nameplate, and secure the pump assembly with the outer nut.

Jets

(1) The jets are fitted to the vehicle during production.

Delivery hoses

(1) Wet the ends of the plastic hoses before fitting.

(2) Fit the valve and sleeve end of the suction hose to the lid of the container and the other end to any one of the pump connections.

(3) Fit the valve end of the delivery hose to the three-way connector and the other end to the remaining pump connection.

(4) Fit the jet hoses to the three-way connector and the jets.

Priming

(1) Fill the container to within 1 in. (25·4 mm.) of the top with clean water or Trico windshield washer fluid.

(2) Depress and release the plunger continuously until fluid emerges from the jets.

(3) Adjust the jet nozzles so that the jet makes contact with the windshield at the top of the wiper sweep. The nozzles may be turned by inserting a pin in the jet orifice, but care must be taken not to enlarge the orifice.

Section R.18

DOOR DRAINAGE

On early vehicles the drainage for the doors may be improved as follows.

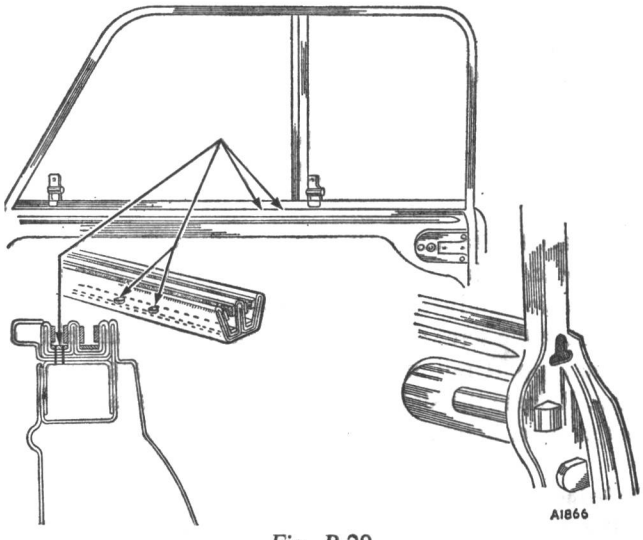


Fig. R.29

Window water drain holes

Doors

(1) Close the door windows.

(2) Mark off two centres in both the front door glass channels, one ½ in. (12·7 mm.) and the other 1 in. (25·4 mm.) in front of the rear sliding glass (see Fig. R.29).

(3) Remove the windows as described in Section R.7 and drill the holes through each channel section and retaining strip.

(4) Refit the channel supports and the windows. Push the rear window vertical channel section down until it abuts the base of the chrome retainer.

(5) Elongate the drain holes in the front and rear of each door until the resulting slots are the same height as the glass channel supports.

Section R.19

ROOF LINER (SALOON)

Removing

Mark the position of the rear edge of the front liner on the side rail to act as a datum for refitting. Remove the liner by gripping the outer edges of the liner and pulling rearwards, at the same time exerting a gentle inwards pressure.

Mark the position of the forward edge of the rear liner, and remove by pulling it forwards, using a gentle inwards pressure at the same time.

When removing the roof liner on the Super model it will first be necessary to remove the roof lamp (see Section N.19).

Refitting

To refit, reverse the above procedure, fitting the rear liner first and ensuring that it is pushed fully home to its original position.

When refitting the front liner check that the three retaining hooks on the forward edge of the rear liner engage in the three sockets formed in the rear rail of the front liner before pushing the liner fully home.

When replacing the roof liner on the Super model thread the roof lamp wires through the front liner before finally pushing the liner home.

Refit the roof lamp.

Section R.20

ROOF LINER (COUNTRYMAN AND TRAVELLER)

Removing

Disconnect the battery and remove the roof light.

Mark the rear edge position of the front liner on the cant rail to facilitate its replacement in the original position. Grip the outside edge of the liner, apply a gentle inward pressure, and at the same time pull the liner rearwards to remove it from the retaining channel.

Remove the trim liner from over the rear door.

Mark the forward edge of the rear liner on the cant rail, apply gentle inward pressure from the outside edges, and pull the liner forward to remove it from the retaining channel.

Refitting

Refit the rear liner, sliding it rearwards until the forward edge is lined up with the mark made on the cant rail to indicate its original position.

Refit the front liner, pushing it forward slowly until the rear edge is lined up with the mark on the cant rail. During this operation make certain that the clip on the front liner enters the bracket on the forward edge of the rear liner.

Refit the roof light, reconnect the battery, and replace the trim liner over the rear door.

Section R.21

BODY SIDE WOOD FRAME ASSEMBLY (COUNTRYMAN AND TRAVELLER)

This wood frame is a complete assembly and must be removed and refitted as such.

Removing

Remove the sliding windows as in Section R.23.

Remove the interior trim liners from the body side and from the rear door pillar. The fuel tank must also be

removed as in Section D.9 when removing the left-hand frame assembly.

Remove the rear door complete with hinges, disconnecting the hinges from the door pillar.

Disconnect the battery and remove the rear lamp assembly.

Mark the fitted position of the wood inserts between the cant rail and the roof panel, and against the front door pillar, to ensure that they can be refitted in exactly the same position from which they were removed. Extract the wood inserts and remove all the screws securing the wood frame to the body from inside the vehicle. Remove the nuts and plain washers from the frame studs protruding through the side panel adjacent to the wheel arch. Access to two of the studs is through the spare wheel compartment.

Carefully ease the wood frame from the body side, extra care being taken when easing it away from the rear bumper.

Refitting

Refitting is a reversal of the removal procedure.

Clean all the old sealing compound from the body panel and the wood frame, and remake the joint with new sealing compound.

Insert all screws before tightening them up.

Section R.22

REAR DOOR WOOD FRAME ASSEMBLY (COUNTRYMAN AND TRAVELLER)

This wood frame is a complete assembly and must be removed and refitted as such.

Removing

Remove the rear door and take off the lock as in Section R.14. A felt covering should be used on the work bench to protect the polished surface of the wood frame.

Remove the two screws from the centre of the inner door panel. Note the two distance pieces.

Remove the door sealing rubber and the retaining clips.

Extract all the self-tapping screws from the edge of the door and carefully ease the frame assembly from the door panel.

Refitting

Clean off all the old sealing compound from the door panel and the wood frame assembly, and remake the joint with new sealing compound.

Refit the wood frame, locating all the screws before finally tightening up.

Clean out all surplus sealing compound, and refit the sealing rubber, using new retaining clips.

Section R.23

BODY SLIDING GLASSES (COUNTRYMAN AND TRAVELLER)

Removing

Extract the retaining screws and remove the trim panel from above the sliding windows.

Locate and remove the self-tapping screws securing both the top sliding channels to the body. Support the glasses on the inside of the vehicle while a second operator pushes the glasses carefully at the top from the outside. The glasses complete with the top channels can then be removed from inside the vehicle.

Refitting is a reversal of the removal procedure.

Section R.24

REAR SEAT (COUNTRYMAN AND TRAVELLER)

Removing

Extract the hexagon set screws from each of the two pivot brackets located on the front lower edge of the rear seat cushion and remove the cushion.

Extract the screws securing the seat back squab hinges to the support rail at the front end of the luggage platform. Release the sliding bolts securing the squab to the seat support brackets and remove the squab.

Refitting

Refitting is a reversal of the removal procedure; make certain, however, that the sliding bolts and the locating pins are lined up before the bracket and hinge screws are fully tightened.

Section R.25

TILT FRAME AND COVER (PICK-UP)

The tilt frame and cover are supplied as a separate kit; the centre and rear hoop sockets, and the front attachment brackets for the struts, are fitted to the vehicle as original equipment.

The sequence and method of fitting is as follows:

(1) Fit the rear hoop ends into the sockets provided at either side of the rear end of the body on its top face. Ensure that the three brackets attached to the top of the hoop face downwards.

(2) Fit the centre hoop ends into the sockets provided at the centre position on the top face of the body.

(3) Engage the studs of one of the struts in the hole in the centre bracket at the top of the rear hoop, the centre hole pierced in the top of the centre hoop, and the hole in the centre bracket attached to the rear of the cab at the top (see Fig. 30). Fit a spring washer and wing nut to each stud and tighten fully (inset [A] of Fig. R.30).

(4) Repeat this operation with the other two struts, using the fixing holes in the brackets and centre hoop either side of the central fixing points.

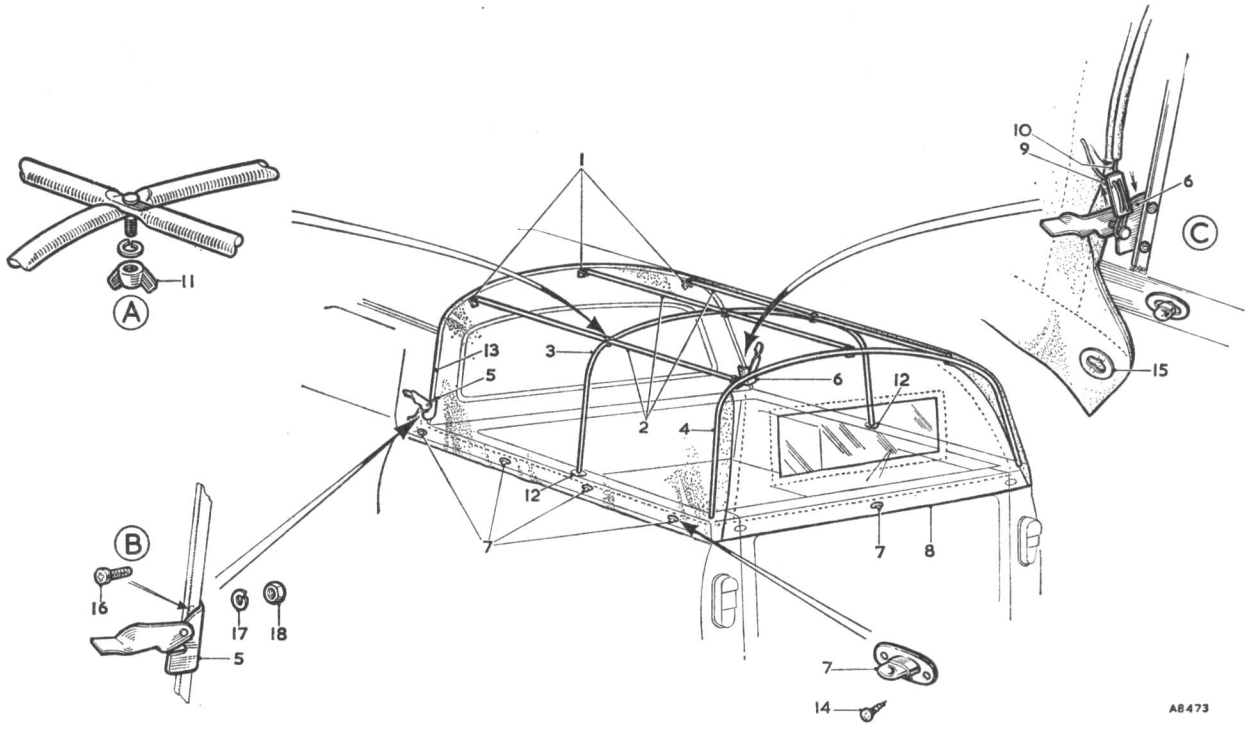


Fig. R.30

The tilt frame and cover assembly

1. Front fixing brackets.
2. Strut.
3. Front hoop.
4. Rear hoop.
5. L.H. lever bracket.
6. R.H. lever bracket.
7. Turn-button.
8. Cover assembly.
9. Adjuster plate—cable.
10. Cover fixing cable.
11. Wing nut—strut to hoop.
12. Hoop housing assembly.
13. Cover retaining channel.
14. Screw—turn-button to body side.
15. Eyelet—tilt cover.
16. Screw—lever bracket to body.
17. Spring washer.
18. Nut for screw.

(5) Place the R.H. lever bracket assembly on the rear face of the channel fixed around the rear of the cab with the drilled face of the bracket against the channel, its lower edge approximately in line with the top edge of the seam—body cross-member to cab. The lever attached to the bracket must face outwards and the lever pin must face forwards.

Mark off the position of the two holes in the drilled face of the bracket onto the body and drill two holes $\frac{13}{64}$ in. (5·16 mm.) diameter. Fix the bracket to the channel with two of the No. 10 pan head screws, nuts, and spring washers, the heads of the screws facing outwards (see inset [B] of Fig. R.30). Repeat this operation with the L.H. bracket on the L.H. side of the channel.

(6) Lay the tilt cover, smooth face upwards, over the tilt frame with the end through which is threaded the fixing cable at the front.

Arrange the centre longitudinal seam to run centrally along the central strut and the centre transverse seam to be central about the centre hoop.

Lift the levers on the brackets to their fullest extent and hook the fixed loop in one end of the fixing cable over the pin of the corresponding lever.

Ensure that the cable running through the tilt cover is forward of the rear edge of the channel round the outer edge of the cab for its full length. Adjust the loop at the other end of the cable until the loop will engage over the pin on its lever without undue slackness in the cable. The adjuster consists of a rectangular plate pierced with four holes. The cable is fed through one hole from the rear of the plate, and then passed down through the hole below and in line along the length of the plate. The loop is formed below the plate, and the free end of the cable is then threaded through the lower vacant hole from the bottom face of the plate, and returns down through the corresponding hole at the top. By adjusting the position of the cable in the plate the length of the cable can be varied as necessary (see inset [C] of Fig. R.30).

With both loops engaged over their respective lever pins, press down each lever in turn until it toggles over into its locked position. The cable should now be holding the front of the tilt cover firmly, and must fit snugly down in the retaining channel throughout its length.

When the adjustment of the cable is satisfactory and the cable and tilt cover are seating correctly in the channel, tuck the free end of the cable back into the tilt cover alongside the cable.

(7) Arrange the tilt cover so that it lies evenly and smoothly over the tilt frame. The fixing position of the turn-buttons can now be marked off, using the eyelets in the lower edges of the cover as templates.

Beginning with the extreme front eyelets, adjust the cover so that it takes its natural position and

mark around the inside of the eyelet on the vertical face of the body. Hold the base of the turn-button against the body in the position so marked and mark and drill the two fixing holes, using a $\frac{7}{64}$ in. (2·78 mm.) diameter drill. Attach the turn-button to the body with two of the No. 6 countersunk self-tapping screws provided.

Repeat this operation on the remaining turn-button positions, working from front to rear, attaching the cover to the body as the work proceeds. Repeat on the opposite side of the body, then lower the rear flap and mark off and fit the turn-button in the centre of the tailboard in the same manner.

(8) Loop the short centre strap attached to the under side of the top of the cover around the central strut and fasten the end together with the turn-button eyelet provided. Attach the corners of the rear flap to the side of the cover by means of the turn-buttons and eyelets provided. The two long straps at the top rear of the cover are for securing the rear flap when it is rolled up and not in use.

Section R.26

INSTRUMENT PANEL
(Super, Super De-luxe, Later Traveller, and Countryman)

Removing

Unscrew and remove the four Phillips screws visible on the front face of the instrument panel shroud, withdraw the shroud, and disconnect the wires to the panel light switch. Disconnect the pipe union from the rear of the oil gauge and disconnect the wires from the back of the temperature gauge.

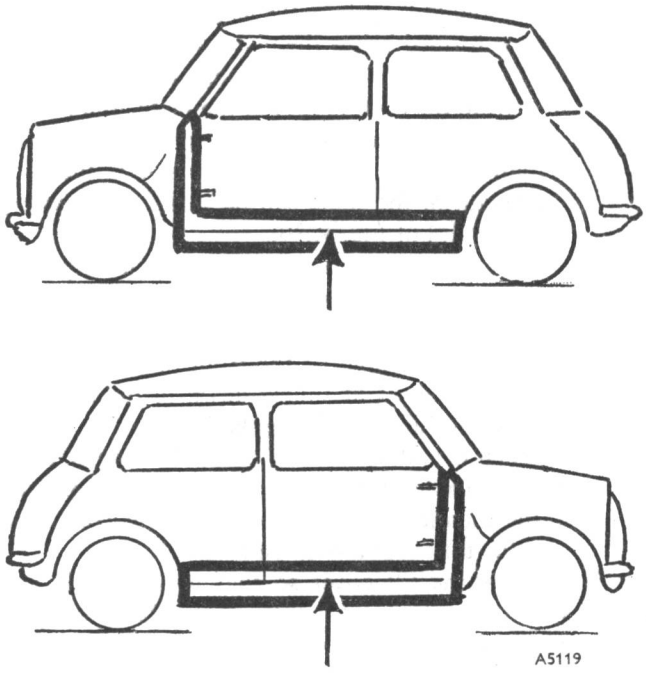


Fig. R.31

The outlined areas indicate the body sections containing rigid foam sealing

Remove the four countersunk Phillips screws on the front face of the instrument panel and withdraw the panel complete with oil gauge and temperature gauge.

Release the two knurled nuts retaining each gauge and withdraw the gauges.

Refitting is a reversal of the removal procedure. Ensure that when the shroud is being refitted the panel light switch is positioned to give a side-to-side action. Should this position of the switch be varied, it could easily result in the switch terminals coming into contact with the oil gauge pipe, thus causing a short circuit in the electrical system.

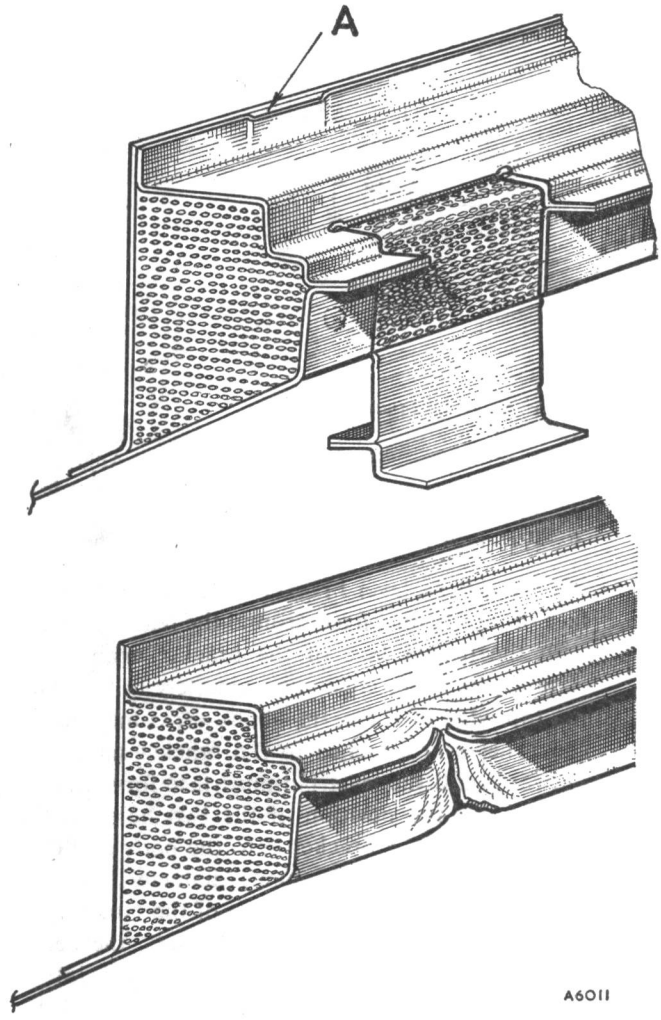


Fig. R.32

The lower illustration shows an example of damage to a sill and the upper illustration demonstrates the method of repair

Section R.27

SPEEDOMETER
(Super, Super De-luxe, Later Traveller, and Countryman)

Removing

Remove the instrument panel (Section R.26) and unscrew the two screws retaining the instrument panel brackets and speedometer to the speedometer cowling, taking care to retain the distance pieces between the

brackets and the cowling. From under the bonnet unscrew the knurled nut retaining the speedometer cable to the instrument and detach the cable. Pull out the four bulb holders from the speedometer and disconnect the cable to the fuel gauge.

Withdraw the speedometer complete with fuel gauge into the engine compartment.

To refit, reverse the removal procedure.

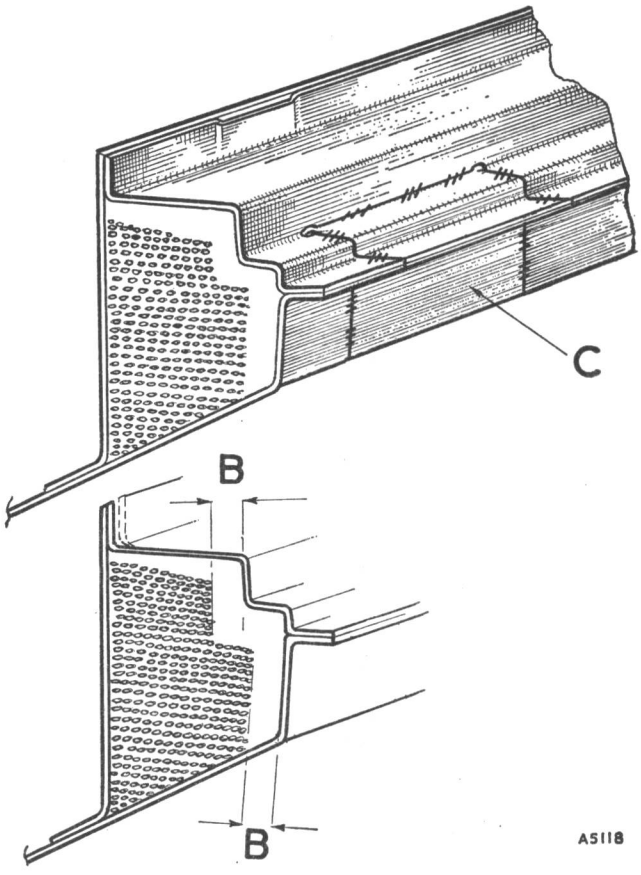


Fig. R.33

Showing the flap tack-welded in position and the rigid foam sealing removed around the area of the repair

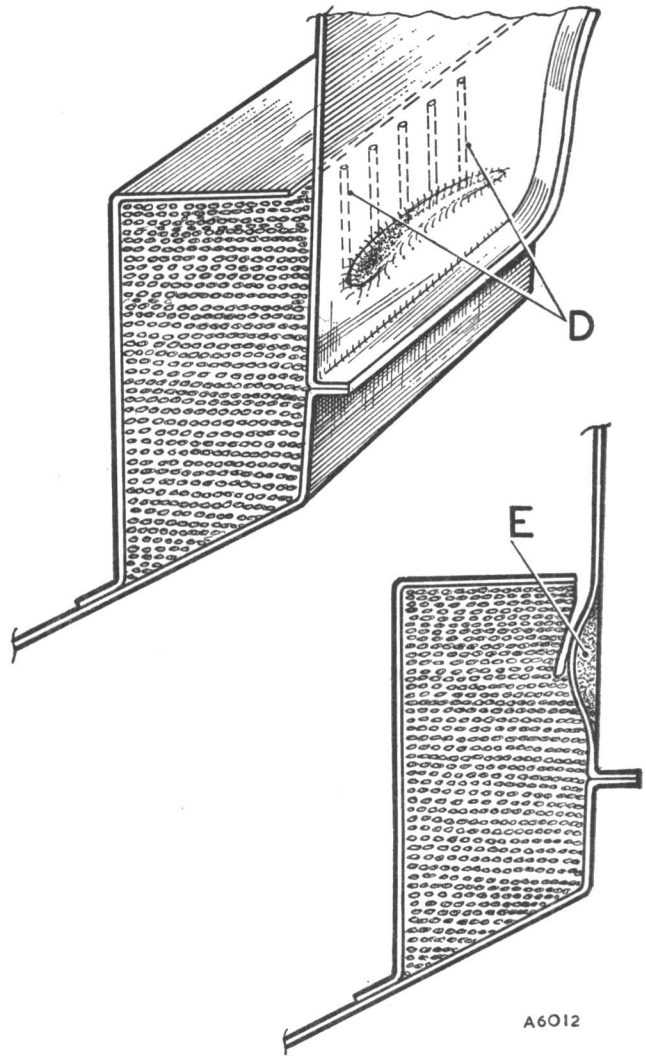


Fig. R.34

Escape vents must be made when lead-filling as shown above

Section R.28

RIGID FOAM SEALING

Rigid foam is a polyurethane sealing material inserted during manufacture into the body frame at the areas indicated in Fig. R.26.

This sealing was introduced at the following body numbers: Saloon (Austin) 41416, (Morris) 31955; Van 10956; Traveller and Countryman 2203. **Under the application of heat—for example, in connection with body repairs involving welding—rigid foam gives off dangerous fumes. A protective air-fed mask incorporating an efficient air filter must be worn, and work must not be carried out in a confined or inadequately ventilated space.**

Repair technique

The following examples are given to show the method of dealing with repair on bodies containing rigid foam sealing.

Assuming damage to one of the sills (Fig. R.32), make a flap of the damaged area and fold it back along the most convenient line. Fig. R.32 shows the flap folded on the lower edge, but it may in some instances be more convenient to fold along the top edge.

Separate the top flanges of the sill as shown at point (A) (Fig. R.32) to provide an outlet for the fumes during welding. Beat out the flap to remove the damage as much as possible.

Remove enough of the foam around the flap area to provide a safety margin of approximately $\frac{3}{8}$ in. (9mm.) as shown at (B) (Fig. R.33) and tunnel up so that the gap thus made is open to the vent (A) (Fig. R.32).

Fold the repaired flap back into position and tack-weld as shown at (C) (Fig. R.33). Tap the joint thus made lightly inwards before making a continuous weld. This will ensure that lead filling will be necessary to bring the level of the flap to its original level, preventing loss of strength in the weld and maintaining the original thickness of the metal after the repair is cleaned off.

Close up the vent made at (A) (Fig. R.32), fill the welded joint with lead, clean off, and paint.

If the damage is merely superficial, the affected area may be tapped inwards to form a suitable depression for lead-filling. Form several escape vents by means of a piece of stout wire as shown at (D) (Fig. R.34) and lead-fill the dent, clean off, and paint.

It will be appreciated that rigid foam cannot be re-introduced to a repaired area.

Rigid foam sealing was discontinued after Car No. AA2S7 62507 and Body No. L69999, with the exception of Body Nos. 70601 to 70630 inclusive.

Section R.29

SEAT BELT FITTING

Attachment points for seat belts are incorporated in the bodies of the Saloon, Countryman, and Traveller and are located on the centre door pillars, the rear of the door sills, and the sides of the central floor tunnel, and are sealed with rubber plugs.

Remove the plug from the tapped attachment point at the top of the door pillar, and assemble the screw, plain washer, anti-rattle washer, and distance piece to the upper bracket of the long belt as shown in the top inset, Fig. R.35. Fit the assembly to the attachment point and tighten the screw fully.

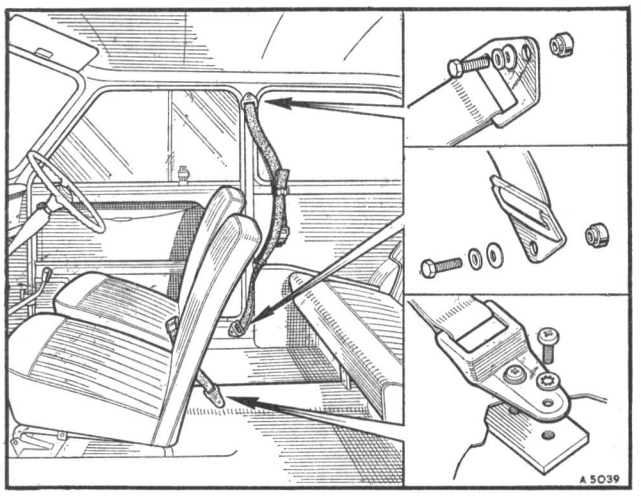


Fig. R.35

Showing the assembly of the seat belt and fittings

Assemble the screw, plain washer, anti-rattle washer, and distance piece to the lower bracket, remove the rubber plug from the sill attachment point, fit the bracket assembly, and tighten the screw fully.

In both the above cases the angle of the belt bracket must face away from the body, and the large diameter of the distance piece must face against the body.

Remove the two plugs from the side of the floor tunnel farthest from the seat for which the belts are being fitted. Cut two holes in the carpet and felt, or rubber, to correspond with the holes in the tunnel.

Fit the tapping plate from the under side of the tunnel, place the bracket of the short belt on top of the carpet, insert the two screws complete with locking washers through the belt bracket into the tapping plate, and tighten fully.

The short belt must cross the tunnel to reach the seat for which it is intended to be used.

NOTE.—The wiring harness runs along the under side of the floor tunnel on the right-hand side adjacent to the tapping plate, and care must be taken to avoid any damage to the wiring.

Mark a vertical line on the waist rail at a distance of $6\frac{1}{4}$ in. (158·8 mm.) from the front face of the door pillar, and, using the stowage clip as a template, mark off and drill two holes ·120 in. (3·05 mm.) diameter on this line. Screw the clip to the waist rail with the two self-tapping screws provided, ensuring that the open end of the clip faces forward (see Fig. R.35).

Position the warning plate on the rear of the front seat squab as near to the top as possible. Drill two holes ·101 in. (2·6 mm.) diameter, and secure the label to the seat with two No. 6 screws provided.

Section R.30

SEAT BELT ANCHORAGE FITTING INSTRUCTIONS (Early Models)

Description

Seat belt kits complete with anchorage fittings are available for fitment to earlier cars. The belts, which may be fitted for both the driver's and front seat passenger's use, are available under Part No. BDA 524 **and should be fitted by an Authorized Distributor or Dealer.**

The kits comprise a long and a short belt, each of which is adjustable. When in use the tongue on the long belt engages a quick-release buckle on the short belt; the positions of the tongue and buckle may be adjusted to suit individual users. A stowage clip is provided to secure the long belt when it is not in use and a warning label is included for the benefit of rear seat passengers.

The upper bracket of the long belt (having two holes) is fitted to the centre pillar and the lower bracket of the belt to the floor adjacent to the sill. The end bracket of the short belt is fitted to the side of the tunnel farthest from the seat being equipped.

The fitting instructions for the anchorages are as follows.

Centre pillar fixing point

(1) Position the upper bracket of the long belt on the centre pillar so that the top hole of the bracket is approximately 4 in. (102 mm.) below the junction of the centre pillar and the cant rail.

(2) From the bracket mark off on the pillar the two holes for the fixing bolts.

(3) Drill two $\frac{5}{16}$ in. (8 mm.) clearance holes through the inner and outer skins of the pillar and at right angles to the pillar.

(4) Enlarge the holes on the outside of the pillar to accept the internally threaded sleeve nuts.

(5) Trim the ends of the sleeve nuts as necessary so that when the heads of the nuts are against the outside of the pillar without the rubber washers in position the ends of the nuts abut the inner face of the pillar.

(6) Fit the rubber washers to the nuts and insert the nuts into the pillar from the outside.

(7) Fit the bracket to the inside of the pillar, using the washers and screws provided.

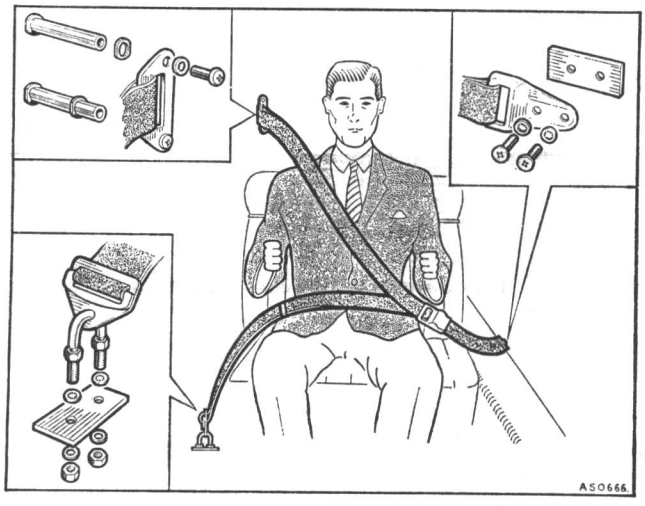


Fig. R.36

The correct sequence of assembly of the components is shown in the inset portions of the illustration

Floor fixing point

(1) Release the floor covering and place the reinforcing plate having the two plain holes on the floor panel behind the centre pillar so that the outer end of the plate abuts the sill and the rear edge of the plate is adjacent to the companion box.

(2) Using the reinforcing plate as a template, mark out and drill two $\frac{5}{16}$ in. (7·94 mm.) clearance holes in the floor panel.

(3) Insert the 'U' bolt through the hole in the remaining end bracket of the long belt and screw one nut onto each arm of the 'U' bolt.

(4) Place a self-locking washer under each nut and insert the 'U' bolt through the holes in the floor.

(5) From the under side of the floor place the reinforcing plate on the 'U' bolt and secure it with the two washers and nuts provided (Fig. R.36).

(6) Cut two slots in the floor covering to enable it to lie flat and refit the covering around the 'U' bolt.

Tunnel

(1) Position the tapped reinforcing plate on the side of the tunnel farthest from the seat being equipped so that the upper hole in the plate is 15 in. (38·1 cm.) behind the floor panel cross-member and $2\frac{3}{4}$ in. (69·8 mm.) down from the centre of the top of the tunnel. Turn the plate around the upper hole to obtain an angle of 45° with the forward floor panel and mark off the holes.

(2) Punch two holes in the floor covering at the positions marked, and, using the holes as guides, mark and drill two $\frac{5}{16}$ in. (7·94 mm.) holes in the tunnel.

(3) Place the reinforcing plate in the tunnel and secure the short belt end bracket to the side of the tunnel with the washers and screws provided. Ensure that the plate is clear of all wiring.

(4) If the set screws protrude through the plate it is important that they be marked, removed, trimmed off flush, and refitted.

Belt clip and warning plate

(1) Position the belt stowage clip horizontally on the waist-rail $6\frac{1}{4}$ in. (158·75 mm.) behind the centre pillar.

(2) Use a No. 31 drill (·120 in. diameter) to drill the two fixing holes in the waist rail.

(3) Secure the clip to the waist rail with the self-tapping screws provided. The open end of the clip faces forward.

(4) Position the warning label on the rear of the front seat squab as near to the top of the seat as possible.

(5) Use a No. 38 drill (·101 in. diameter) to drill the two fixing holes.

(6) Secure the label to the squab with the two No. 6 screws provided.

Section R.31

BODY ALIGNMENT

To check the body alignment of a car which has been damaged when the correct jig is not available a system of diagonal and measurement checks from points projected from the underframe onto a level floor is used (see pages R.27 and R.28).

To ensure that the alignment check is carried out accurately the vehicle must be raised so that it is parallel with the floor both from side to side and from front to rear. Use the comparative measurements given on page R.28 to do this. Lift the vehicle to a convenient working height and adjust the front or rear of the vehicle until the points given on page R.28 for the front and rear on both sides of the car are in the correct vertical position relative to each other; for example, if the rear points (O) are 36 in. (91·4 cm.) from the floor, as the rear points are $1\frac{27}{64}$ in. (36·12 mm.) higher in relation to the front points (A), the front points must be set at a height of $34\frac{37}{64}$ in. (87·828 cm.) above the floor.

At the same time, it will be helpful to check the **relative** heights of all the intermediate points given on page R.28 so that any distortion of the car in the vertical plane will be ascertained.

Chalk over the area of the floor directly below the points shown on page R.27. Using a plumb-line, project the points from the car onto the floor, marking the positions with a pencilled cross. The centre between each pair of points can be established by means of a large pair of compasses and the central points marked on the floor. In addition, diagonals can be determined between any two pair of points and the points of intersection marked on the floor. At this stage a length of thin cord covered with chalk can be held by two operators in such a position that it passes through as many of the central points and intersections marked as possible. While the cord is held taut a third operator raises the centre of it and then allows it to spring back smartly to the floor. If the resulting white line passes through all the points the body alignment is satisfactory. Any points through which the white line does not pass will be in a position where the underframe is out of alignment.

Considerable deviations in the transverse and longitudinal measurements given on pages R.27 and R.28 confirm body misalignment. It must be understood that allowance must be made for normal manufacturing tolerances and that a reasonable departure from nominal dimensions can be permitted without detriment to road performance.

Section R.32

CHECKING BODY ALIGNMENT

The equipment required for checking the body alignment consists of the basic body checking jig Service tool 18G 560, and adaptor set 18G 560 E used in conjunction with basic adaptor set 18G 560 A.

This equipment is intended to be used solely as a checking fixture, and under no circumstances must any welding or repair work be carried out on the body while it is still in position on the jig.

Assembling the jig

Where item numbers are quoted in this sub-section refer to Fig. R.37.

Remove the two inner socket screws from each corner plate on the front cross-member of the basic jig. Attach the two tall support pedestals (1) from adaptor set 18G 560 E to the cross-member at these points. Each pedestal is clearly labelled to show its correct location directionally. Fit the plate marked 'Forward 1' (2) from the basic adaptor set 18G 560 A and the plate marked 'Forward 2' (3) from the adaptor set 18G 560 E to the basic jig at the points indicated on the inside of the left-hand side-member.

Attach the shorter pair of support pedestals (4) from adaptor set 18G 560 E to the rear of the front checking frame (13). Mount the frame with the rear pedestals on plate 1 (2) and attach the frame to the front pedestals and the rear pedestals to the plate.

Fit the two checking adaptors (5) and the two jacking screws (6) from 18G 560 E to plate 2 (3). Place the short jacking bar (7) from adaptor set 18G 560 in position on the jacking screws.

Attach the two jacking screw brackets (8) from 18G 560 E to the side-member of the basic jig at the

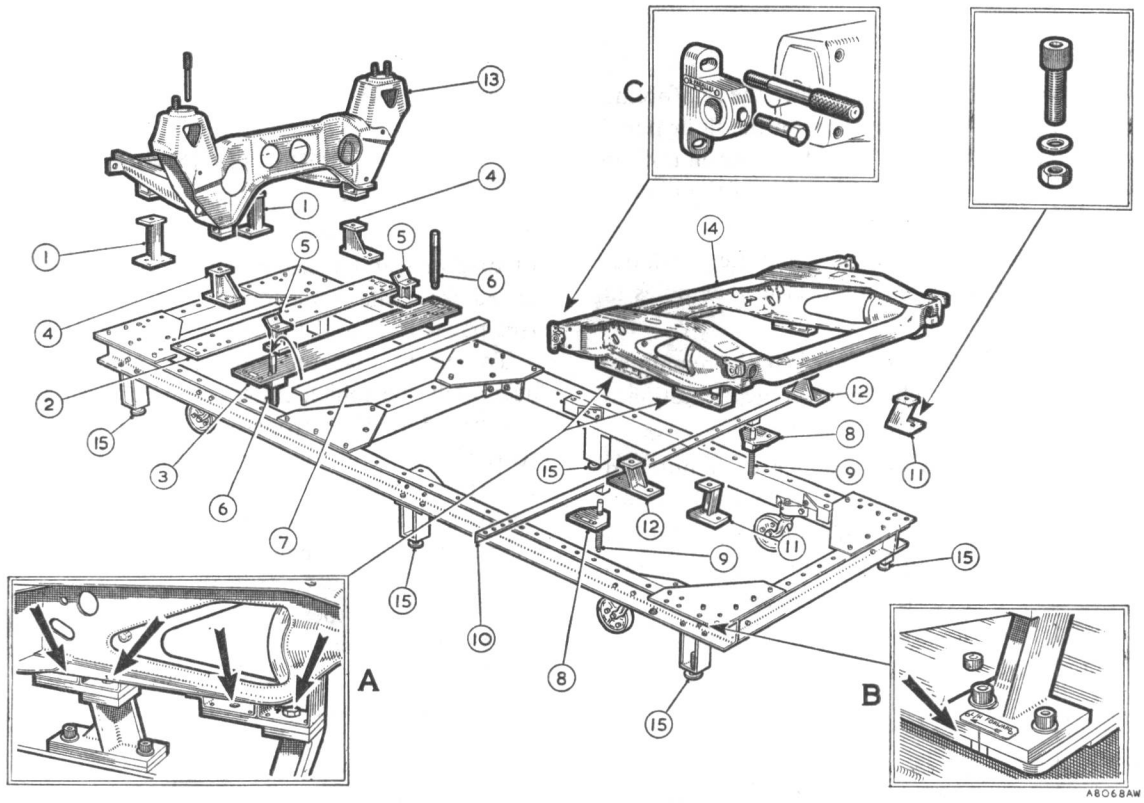


Fig. R.37

The assembly of the jig components

position marked 'OX' on the top of the left-hand side-member and at the corresponding position on the right-hand side-member.

Screw in the two longer jacking screws (9) from adaptor set 18G 560 A. Assemble the long jacking bar (10) from 18G 560 A and place in position on the screws.

Fit the two support pedestals (11) from 18G 560 E to the rear of the jig corner plates.

Attach the other pair of pedestals (12) from 18G 560 E to the front of the rear checking frame (14) and mount the checking frame on the rear pedestals and the side-members of the basic jig. Do not tighten completely the pedestal to jig fixing bolts.

NOTE.—The rear checking frame has two alternative pairs of holes each side for attachment to the pedestals. The forward pair are for use when checking the body of a Van, Countryman or Traveller, the rear pair are for use when checking a Saloon body (see inset [A]).

When the assembly of the jig and adaptor sets is complete, adjust the basic jig by means of its six adjustable feet (15) (one at each corner, one on each side) until the weight is taken from the castors and the jig is level. Levelling indicators are provided, one on each side-member and one on the front cross-member.

Remove the four pins with knurled heads (12) from the top checking faces (2) of the front checking frame.

Move the rear checking frame to its most rearward position by means of the slotted holes in the base of the pedestal supports.

Lower the body squarely over the checking frames until it rests on the jacking bars.

At no time must the weight of the body be taken by the checking frames.

Lower the jacking bars equally, keeping the body square with the jig, until the body is lightly in contact with the top faces (2) of the front checking frame.

Insert the four pins (12) through the holes in the body and into the holes in the top faces of the front checking frame. Check the relation of the holes in the body to the plain shank of the checking pins. The ideal position is when each of the holes in the body is concentric with the shank of its checking pin (see Fig. R.39). Adjust the body on the jig until this position, or the nearest possible approach to it, has been attained.

Line up the top holes in the front checking brackets (8) of the rear checking frame with the corresponding holes in the body. Insert one of the threaded checking pins (13) in each side to check this alignment.

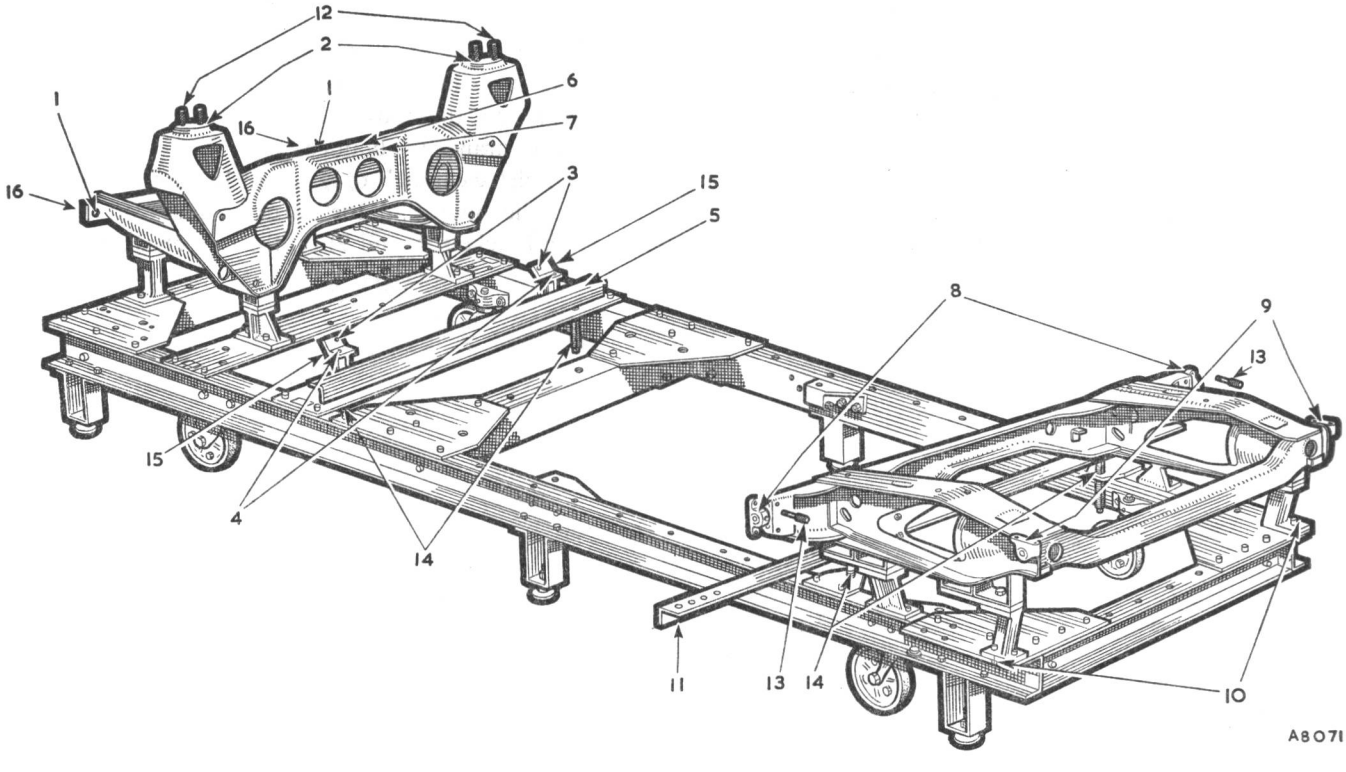


Fig. R.38
The jig checking points

If a fixed-position hoist is to be used to lift the body onto the jig, the jig must be levelled up in a central position under the hoist with the body already raised.

Checking alignment

All item numbers quoted in the following description refer to Fig. R.38.

Move the rear checking frame forward until a parallel clearance of $\frac{1}{8}$ in. (3·18 mm.) is obtained between the forward faces of the front checking brackets (8) and the body (a drill shank is a convenient gauge to use when checking these clearances).

Tighten down the pedestal fixing bolts, and check the relative positions of the lines scribed on the outer edge

of each rear pedestal and the lines scribed on either outer edge of the jig rear corner plates (10). The ideal position is when the lines on the pedestals coincide with the central lines on the corner plates (see inset [B], Fig. R.37). The lines scribed either side of each central line show the maximum permissible limits of adjustment, and the correct clearance between the checking bracket and the body must be obtained with the adjustment set within these limits.

Should the body be damaged in such a way that it is impossible to lower the body on the checking jig with all

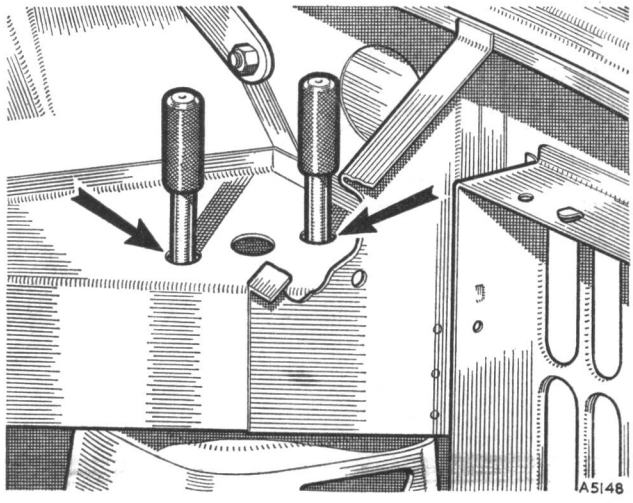


Fig. R.39

Showing an equal clearance around the checking pins with the body correctly aligned

of the checking brackets on the rear checking frame in position, it is possible to detach either bracket by removing the hexagon-headed dowel bolt passing through the bracket, which can then be pulled off its mounting point.

After the correct location of the body on the jig has been established at the top checking faces on the front frame (2), and at the top holes of the front checking brackets (8) on the rear frame, the remaining alignment points and clearance can be checked.

The two checking holes (1) on the front member of the front checking frame, the four holes on the checking adaptors (3 and 4), and the eight holes in the front and rear checking brackets (8 and 9) on the rear checking frame should all line up by sight with their corresponding holes in the body.

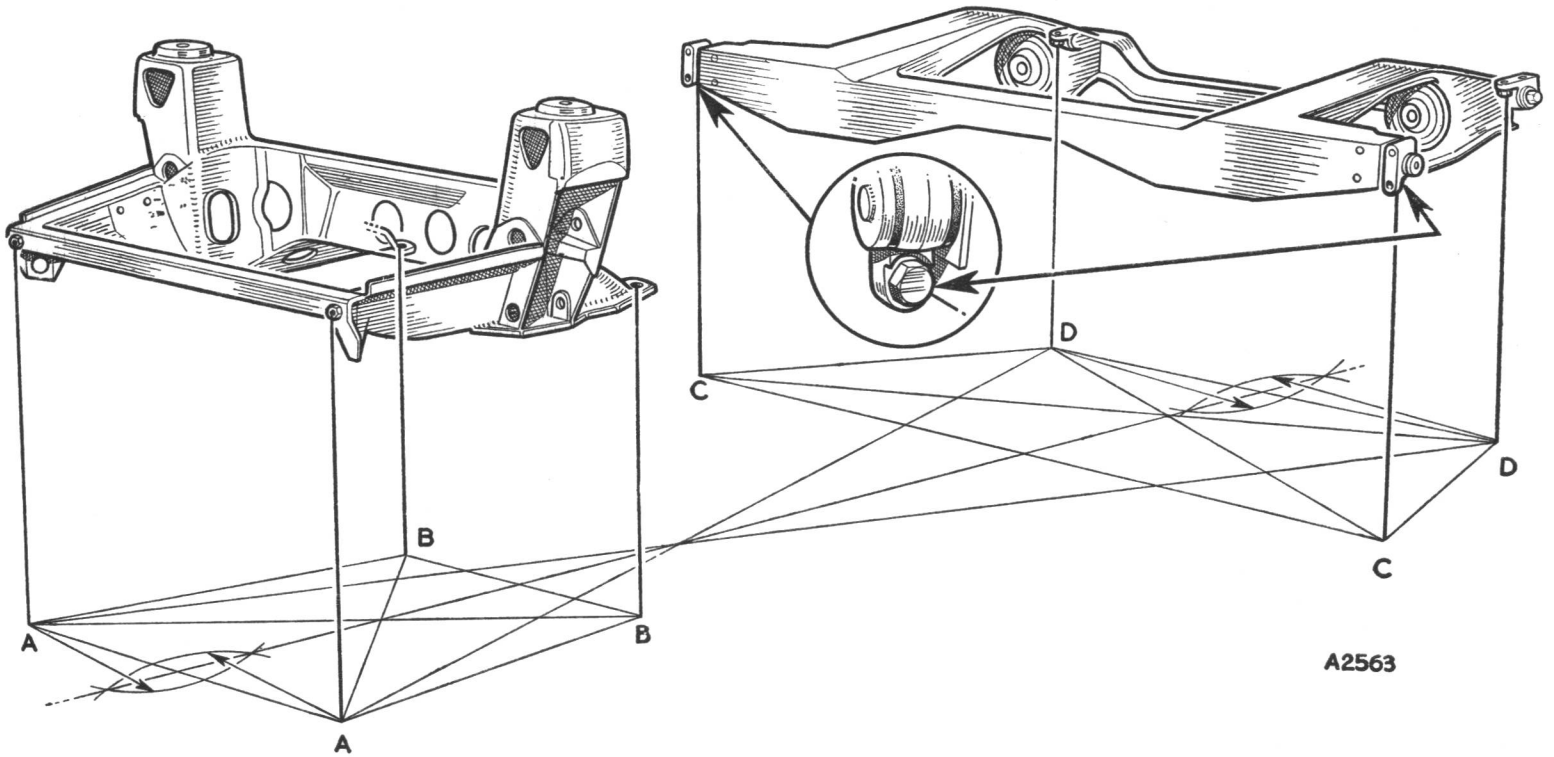
A parallel clearance of $\frac{1}{4}$ in. (6·35 mm.) must exist between the checking faces (16) on the front member of the front checking frame and the body and between both faces of each checking adaptor (15) and the under side of the body floor.

Examine the clearance between the body and the front checking frame at all points, including around the sides of the frame towers. If there is a foul at any point, the body must be dressed back until a clearance is obtained.

The face of the cross-member at the rear of the front frame must have a clearance to the body on its top vertical face (6) of $\frac{1}{8}$ in. (3·18 mm.). and $\frac{1}{16}$ in (1·599 mm.) clearance at the inclined face (7). Should these clearances not be present, the body must be dressed back until the requisite clearance is obtained.

A parallel clearance of $\frac{1}{8}$ in. (3·18 mm.) must exist between the body and the checking faces of the four checking brackets (8 and 9) on the rear checking frame.

HORIZONTAL ALIGNMENT CHECK



TRANSVERSE DIMENSIONS

AA
Width between centres of the front sub-frame front mounting set screws
26 in. (660·4 mm.)

BB
Width between centres of the front sub-frame rear mounting set screws
16¼ in. (412·75 mm.)

CC
Width between centres of the rear sub-frame front mounting block lower set screws
50½ in. (1282·7 mm.)

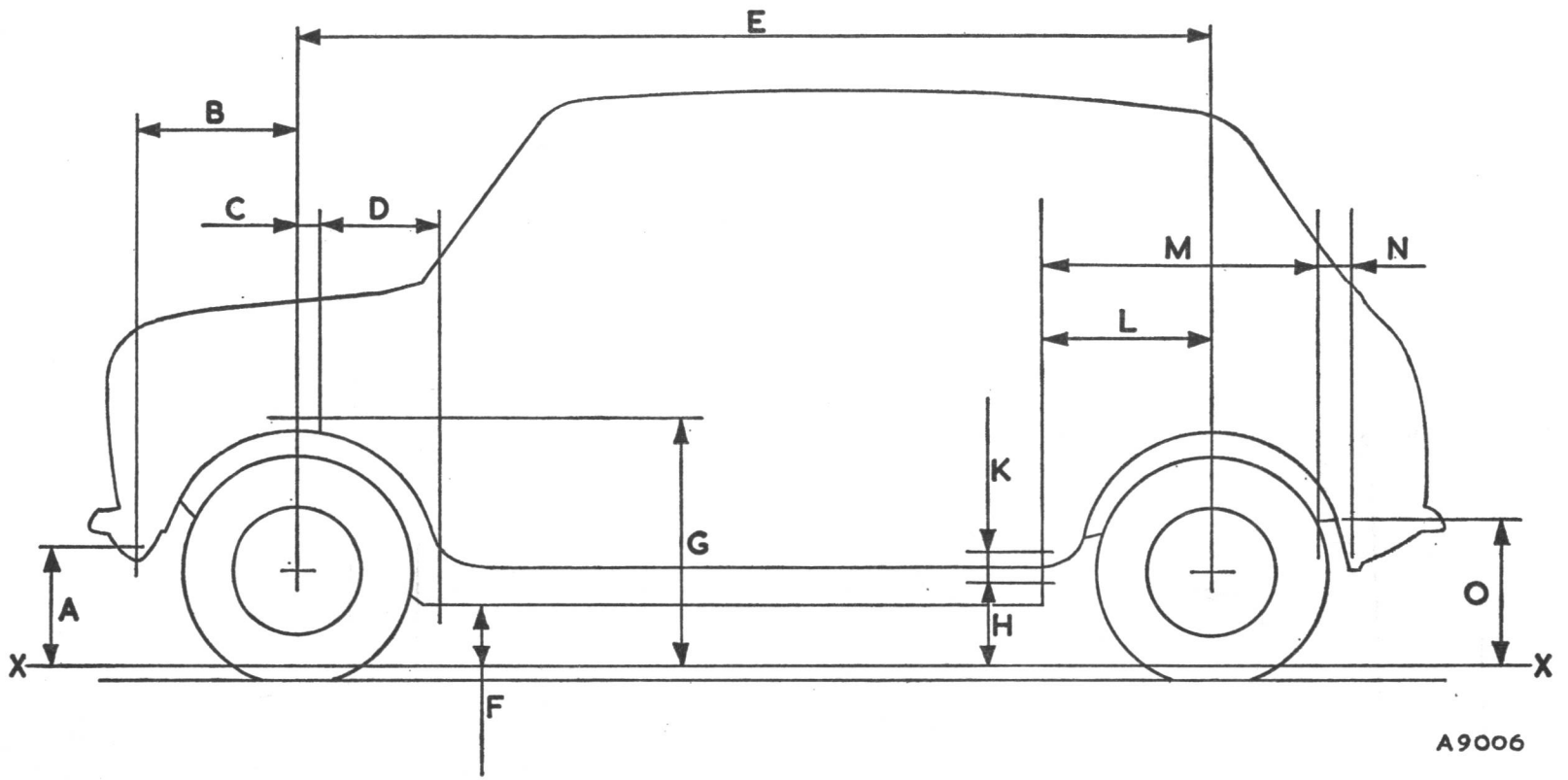
DD
Width between centres of the rear sub-frame rear mounting block set screws
38½ in. (977·9 mm.)

A preliminary check of the alignment can best be carried out by the system of diagonals and measurement checks from points projected onto a level floor by means of a plumb-bob.

A centre-line can then be established by means of a large pair of compasses and any deviation from correct alignment will be evident by failure of the diagonals to intersect on the centre-line or by considerable deviations in the measurements.

R

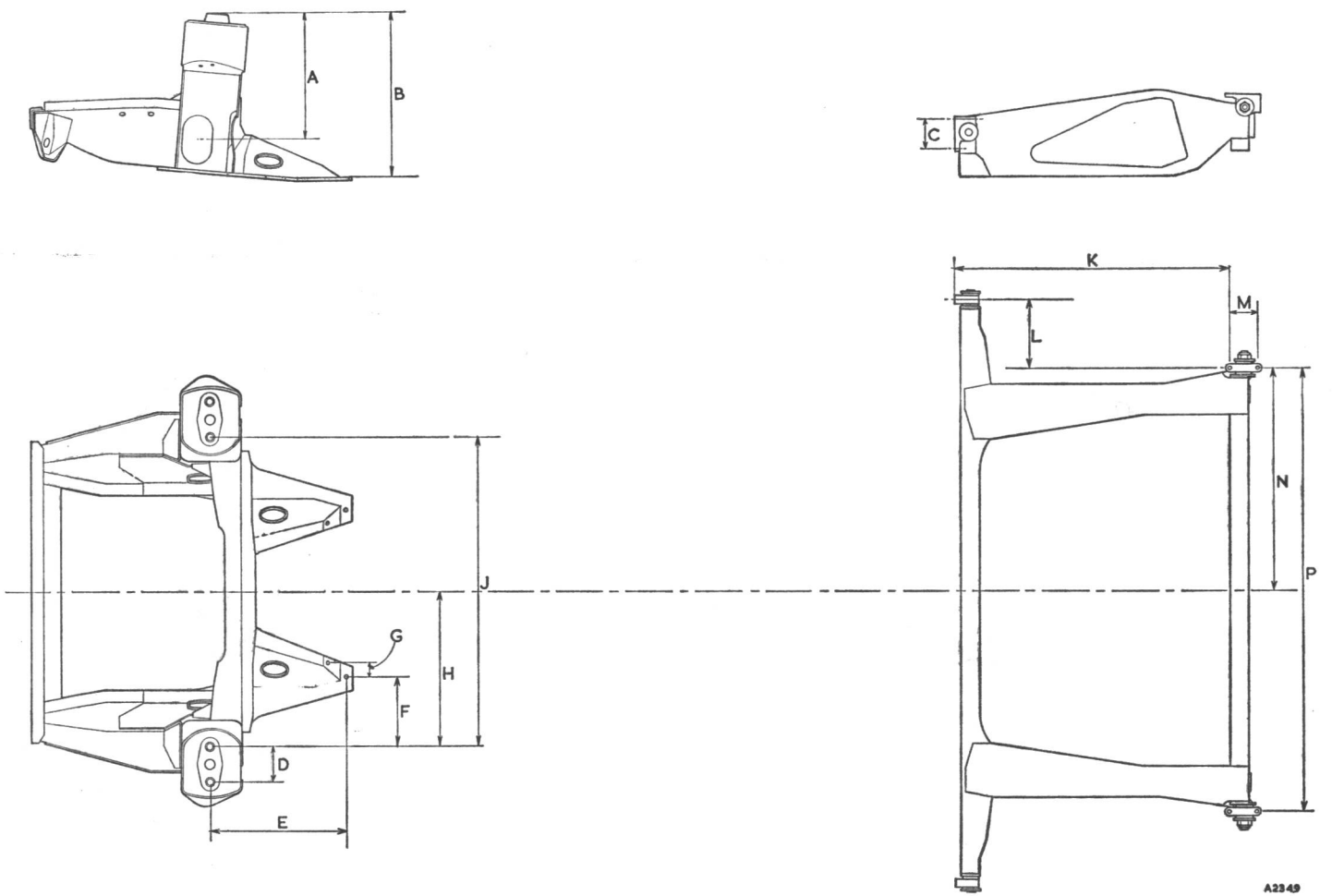
VERTICAL ALIGNMENT CHECK



Code Letter	*Dimension*	*Location*
A	10 13/16 in. (274·64 mm.)	Front sub-frame mounting (front)
B	16 11/16 in. (423·86 mm.).	Front sub-frame mounting (front) to wheel centre
C	1 25/32 in. (45·24 mm.)	Wheel centre to tower mounting
D	10 7/32 in. (259·56 mm.)	Front sub-frame mounting (tower) to front sub-frame mounting (extreme rear)
E	80 5/32 in. (2036·37 mm.)	Saloon — wheelbase
	85 5/32 in. (2137·97 mm.)	Van, Countryman, Traveller, and Pick-up — wheelbase
F	5 27/32 in. (148·43 mm.)	Body sill to datum line
G	20 37/64 in. (523·08 mm.)	Tower mounting (sub-frame) to datum line

Code Letter	*Dimension*	*Location*
H	8 3/4 in. (212·72 mm.)	Lower rear sub-frame mounting (front) to datum line
K	2 1/4 in. (57·15 mm.)	Mounting hole centres—rear sub-frame mounting (front)
L	14 29/64 in. (367·11 mm.)	Rear sub-frame mounting (front)—body face to wheel centre
M	23 37/64 in. (599·28 mm.)	Rear sub-frame mounting (front)—body face to rear sub-frame mounting (rear) forward fixing hole
N	2 1/4 in. (57·15 mm.)	Rear sub-frame mounting (rear) fixing hole centres
O	12 15/64 in. (310·75 mm.)	Rear sub-frame mounting (rear)—body face to datum line

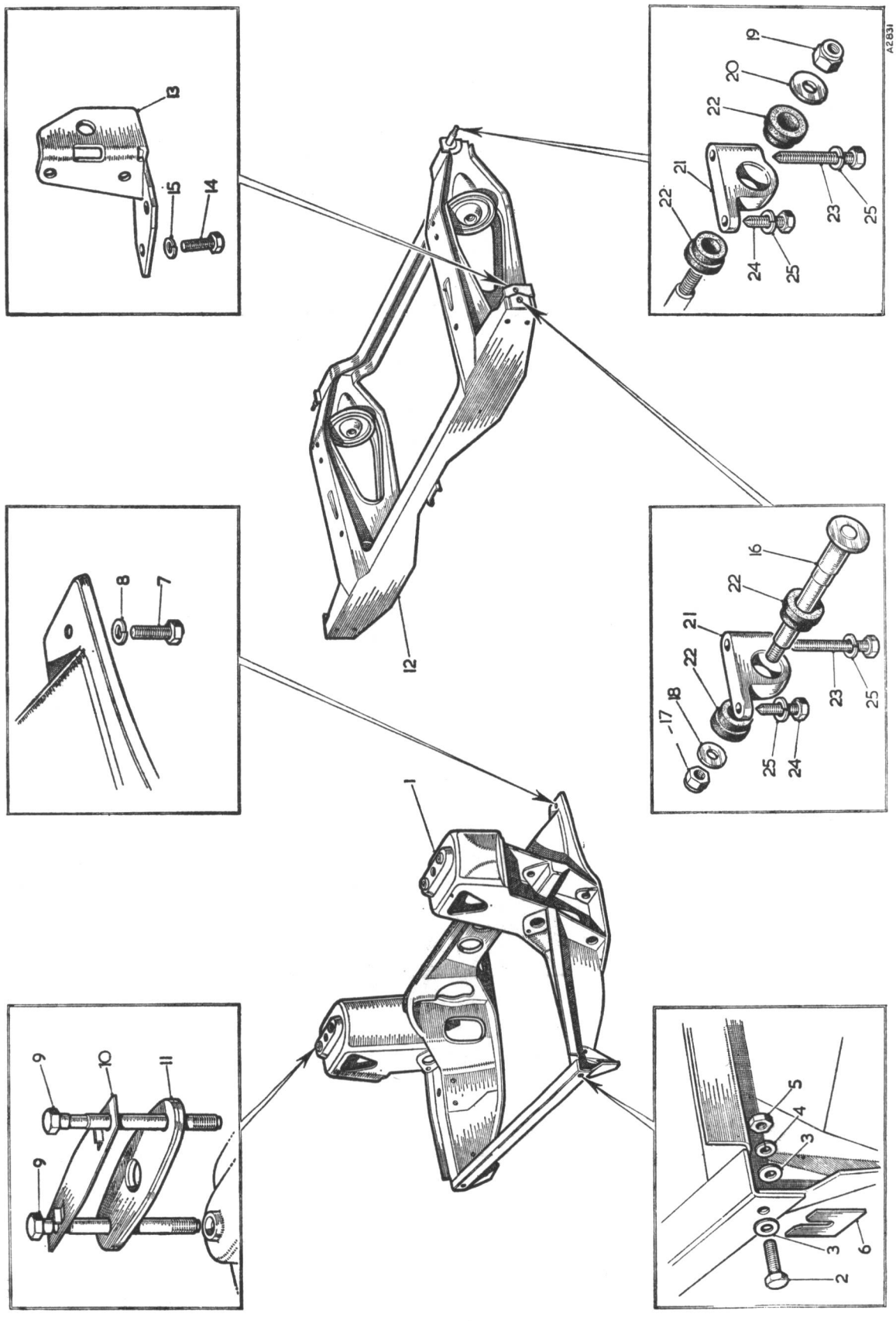
SUB-FRAME ALIGNMENT DIAGRAM



KEY TO DIMENSIONS

A. $10\frac{47}{64}$ in. $\pm\frac{1}{0}$ in. (276·62 mm. $\pm\,^{1\cdot59}_{0}$ mm.).
B. $14\frac{47}{64}$ in. $\pm\frac{1}{0}$ in. (374·45 mm. $\pm\,^{0}_{1\cdot59}$ mm.).
C. $2\frac{1}{4}$ in. ± ·010 in. crs. (57·15 mm. ± ·254 mm.).
D. 3 in. ± ·010 in. crs. (76·20 mm. ± ·254 mm.).
E. $10\frac{7}{32}$ in. $\pm\frac{1}{32}$ in. (259·56 mm. ± ·800 mm.).
F. $5\frac{1}{2}$ in. ± ·010 in. (139·7 mm. ± ·254 mm.).
G. $1\frac{1}{2}$ in. (38·10 mm.).
H. $13\frac{5}{8}$ in. $\pm\frac{1}{32}$ in. (346·08 mm. ± ·800 mm.).
J. $27\frac{1}{4}$ in. ± ·010 in. (692·55 mm. ± ·254 mm.).
K. $23\frac{47}{64}$ in. $\pm\frac{1}{32}$ in. (598·88 mm. ± ·800 mm.).
L. 6 in. ± ·010 in. (152·4 mm. ± ·254 mm.).
M. $2\frac{1}{4}$ in. ± ·010 in. crs. (57·15 mm. ± ·254 mm.).
N. $19\frac{1}{4}$ in. $\pm\frac{1}{32}$ in. (488·75 mm. ± ·800 mm.).
P. $38\frac{1}{2}$ in. ± ·010 in. (977·5 mm. ± ·254 mm.).

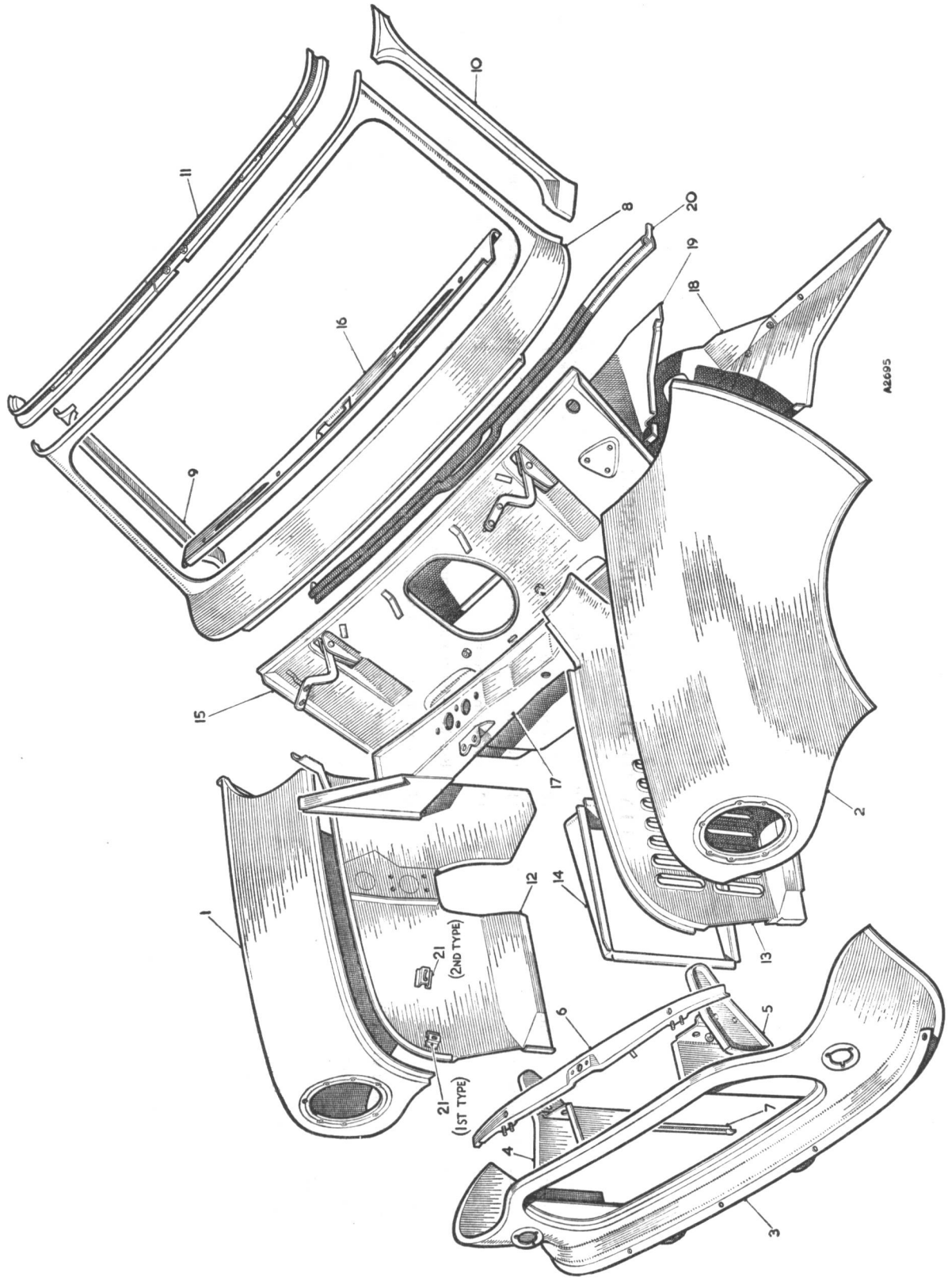
THE SUB-FRAME ASSEMBLIES



KEY TO THE SUB-FRAME ASSEMBLIES

No.	*Description*
1.	Sub-frame assembly—front.
2.	Bolt—sub-frame to body.
3.	Washer for bolt.
4.	Washer for nut.
5.	Nut for bolt.
6.	Packing—sub-frame to body.
7.	Screw—sub-frame to body.
8.	Washer for screw.
9.	Screw—tower to bulkhead.
10.	Washer for screw.
11.	Pad—pressure—towers to bulkhead.
12.	Sub-frame—rear.
13.	Bracket—outer radius arm.
14.	Screw—bracket to frame.
15.	Washer for screw.
16.	Pin—front support.
17.	Nut for support pin.
18.	Washer for nut.
19.	Nut—rear support pin.
20.	Washer for nut.
21.	Mounting—support pin.
22.	Bush for support pin.
23.	Screw for support pin.
24.	Screw for support pin.
25.	Washer for screw.

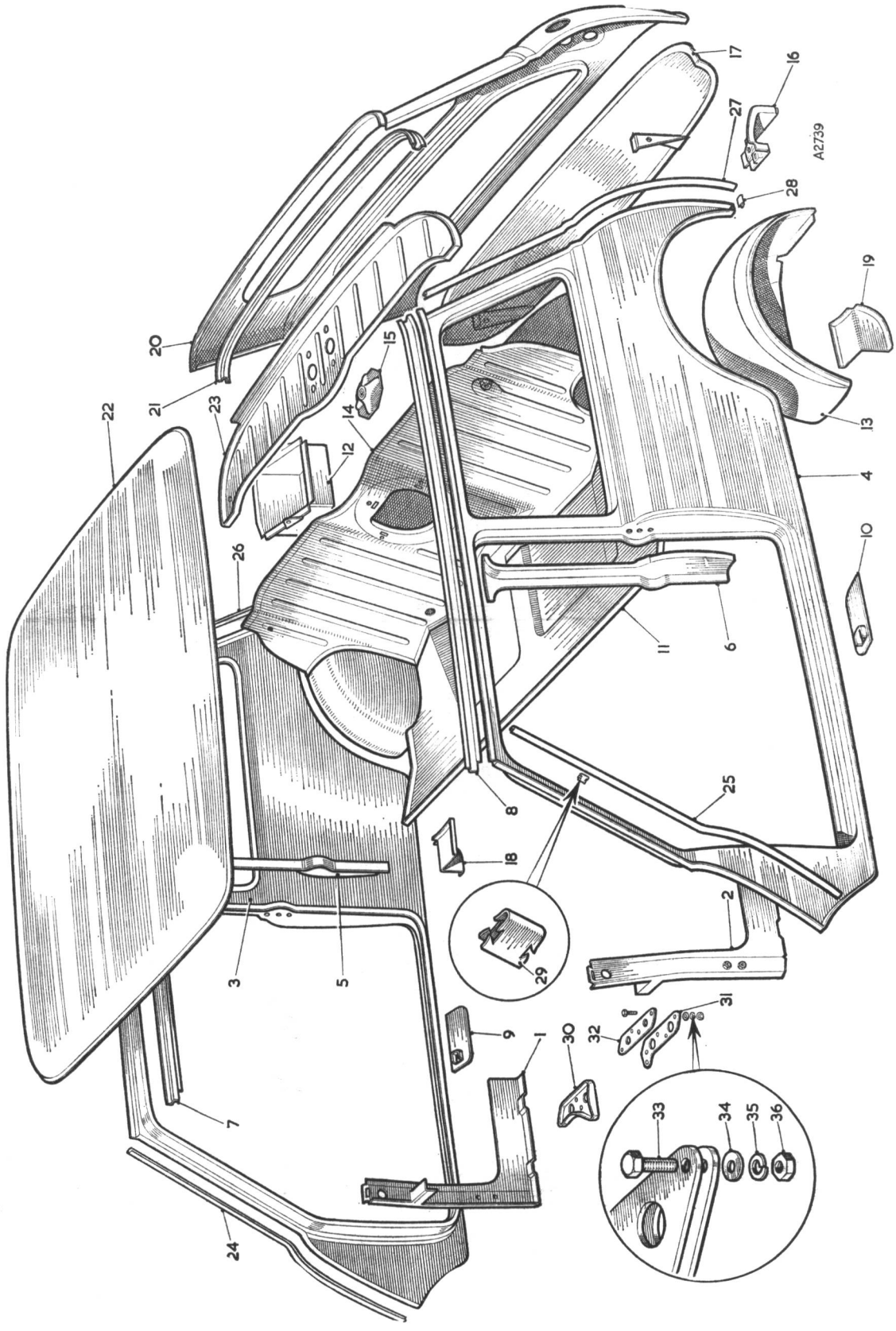
THE FRONT BODY PANEL COMPONENTS



KEY TO THE FRONT BODY PANEL COMPONENTS

No.	*Description*
1.	Wing assembly—front—R.H.
2.	Wing assembly—front—L.H.
3.	Panel assembly grille.
4.	Bracket attachment—front—R.H.
5.	Bracket attachment—front—L.H.
6.	Stiffener—grille panel.
7.	Stay—grille panel.
8.	Panel assembly—windscreen.
9.	Boxing plate—front pillar—R.H.
10.	Boxing plate—front pillar—L.H.
11.	Cant rail assembly—front.
12.	Wing valance—R.H.
13.	Wing valance—L.H.
14.	Radiator cowl.
15.	Panel assembly—dash.
16.	Panel assembly—fascia.
17.	Cross-member assembly—dash panel.
18.	Panel assembly—toeboard.
19.	Panel—parcel shelf front.
20.	Moulding—front parcel tray.
21.	Bracket for prop rod.

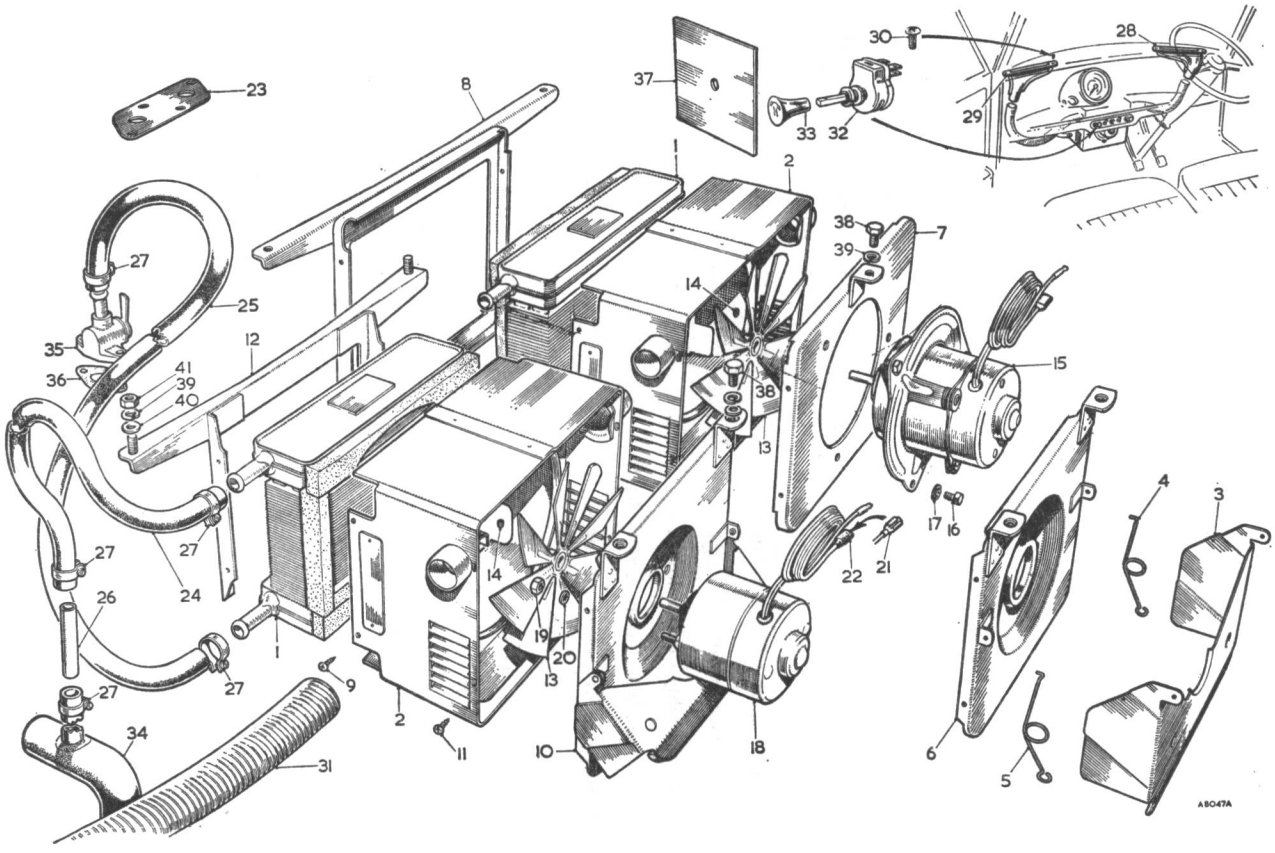
THE BODY PANEL COMPONENTS



KEY TO THE BODY PANEL COMPONENTS

No.	*Description*
1.	Boxing plate—front lower—R.H.
2.	Boxing plate—front lower—L.H.
3.	Panel assembly—body side—R.H.
4.	Panel assembly—body side—L.H.
5.	Centre pillar assembly—R.H.
6.	Centre pillar assembly—L.H.
7.	Cant rail assembly—R.H.
8.	Cant rail assembly—L.H.
9.	Bracket—jack reinforcement—R.H.
10.	Bracket—jack reinforcement—L.H.
11.	Seat pan and rear floor assembly.
12.	Box—battery.
13.	Panel assembly—wheel arch—L.H.
14.	Panel—seat brace.
15.	Bracket—spare wheel mounting.
16.	Plate reinforcement.
17.	Panel assembly—back—lower.
18.	Filler—rear wheel arch—front—R.H.
19.	Filler—rear wheel arch—front—L.H.
20.	Panel assembly—back.
21.	Cant rail assembly—rear.
22.	Panel assembly—roof.
23.	Panel—parcel shelf—rear.
24.	Finisher—front—R.H.
25.	Finisher—front—L.H.
26.	Finisher—rear—R.H.
27.	Finisher—rear—L.H.
28.	Finisher—rear—lower.
29.	Clip—finisher retaining.
30.	Seating plate.
31.	Blanking plate.
32.	Blanking plate.
33.	Screw.
34.	Washer.
35.	Spring washer.
36.	Nut.

THE HEATER ASSEMBLY COMPONENTS
(Recirculatory Type)



No.	*Description*
1.	Radiator.
2.	Cowling.
3.	Flap—demister.
4.	Spring flap—demister—R.H.
5.	Spring flap—demister—L.H.
6.	Cover and motor mounting plate (first type).
7.	Cover and motor mounting plate (second type).
8.	Mounting bracket assembly (early type).
9.	Screw—cowling to bracket.
10.	Cover and motor mounting plate (third type).
11.	Screw—cowling to mounting plate.
12.	Mounting bracket assembly (later type).

No.	*Description*
13.	Fan assembly.
14.	Screw—fan retaining.
15.	Motor and mounting assembly (first type).
16.	Screw—motor to mounting plate.
17.	Shakeproof washer.
18.	Motor (later type).
19.	Nut—motor to mounting plate.
20.	Shakeproof washer.
21.	Lucar connector—female.
22.	Sleeve for connector.
23.	Plate—blanking—dash cross-member.
24.	Heater hose—inlet.
25.	Heater hose—outlet.
26.	Connection for hoses.

No.	*Description*
27.	Hose clip.
28.	Duct assembly—demister—R.H.
29.	Duct assembly—demister—L.H.
30.	Screws—ducts to fascia panel.
31.	Hose—demister.
32.	Switch—heater.
33.	Knob for switch.
34.	Hose—radiator to water pump.
35.	Tap—heater control.
36.	Washer for tap.
37.	Washer—plate.
38.	Screw—heater fixing.
39.	Spring washer.
40.	Plain washer.
41.	Nut for screw.

Section R.33

PAINT REFINISHING INSTRUCTIONS

Operation	*Material*	*Thinning*	*Drying times*	*Application*	*Instructions*
Stripping original paint	Water-soluble paint remover, e.g. Sunbeam Anti-corrosives 'Stripolene 799'	—	—	Brush	Remove the original finish with a scraper after allowing paint-strip 10 minutes to react (repeat if necessary). Wash off thoroughly with cold water, rubbing with wire wool. Dry. Blow out crevices with compressed air. Strip a small area at a time to enable correct neutralizing of the stripper
Metal abrading	Emery-cloth, e.g. Howarth Blue Twill, grade 1½ M	—	—	Hand or disc	Paper thoroughly to ensure satisfactory key. Wipe with cleaner solvent or white spirits
Acid etching	Apply Deoxidine 125 (I.C.I.)	1 part Deoxidine, 1 part water	—	Brush	Apply solution generously and rub in with wire wool. Do not allow Deoxidine solution to dry off before the wash-off operation. Allow approximately five minutes to complete reaction. Wash thoroughly with cold water to remove all traces of Deoxidine solution, followed by a hot rinse. Thoroughly dry surfaces with a clean cloth and blow out crevices with compressed air
Priming	Synthetic primer G.I.P. No. S3178	6 to 1 with Z1048	½-hour to 4 hours	Spray	Apply one thin coat of synthetic primer (recommended for superior adhesion) or one thin coat of cellulose primer (recommended for good adhesion). The use of a primer coat enhances adhesion and gives the system a much greater safety factor
	or Grey cellulose primer G.I.P. C3971 MOD	50/50 with 2045M	¼-hour	Spray	
Applying stopper	Stopper Grey G.I.P. 824D or Stopper Brown G.I.P. 1543	—	6–8 hours or overnight if possible	Glazing knife	Apply stopper in thin layers, allowing 15–20 minutes' drying between applications. Heavy layers result in insufficient drying, with subsequent risk of cracking
Filling	Primer Filler Grey G.I.P. C3663M	50/50 with 2045M	3–4 hours	Spray	Apply two or three full coats, allowing 15–25 minutes' drying time between coats

Continued on page R.38

PAINT REFINISHING INSTRUCTIONS

Operation	*Material*	*Thinning*	*Drying times*	*Application*	*Instructions*
Wet-sanding	Abrasive paper 280 grade	—	—	—	Rub down wet until smooth; a guide coat (a weak contrasting colour) may be used to ensure that the whole surface is rubbed level. Wash off thoroughly with water, sponge all sludge, wash off, dry with clean sponge. Dry off. Minimum of paint should be removed consistent with a satisfactory surface. Film thickness after rubbing should be ·0025 in. (·06 mm.) min.
Applying sealer or undercoat	Sealer Grey or Sealer White or Red undercoat	50/50 with 2045 M	15–20 minutes	Spray	Apply one coat, flash off
Dry-sanding or de-nibbing as required	320 grade paper	—	—	——	De-nib or dry-sand with 320 paper. Clean with white spirit. The grade of paper quoted is from the 3M Company (Minnesota Mining and Mfg. Co. Ltd.); the grade of paper may vary according to manufacture
Applying colour coats	BMC body finishes	50/50 with 2045M	5–10 minutes' flash between coats	Spray	Apply two double coats with a 5–10-minute flash between coats. Overnight dry
Flatting colour coat	320 or 400 paper	—	—	Hand	Flat with 320 or 400 paper, dependent on conditions
Applying final colour coat	BMC body finishes	50/50 with 2045M	Overnight dry	Spray	Spray final double colour coat
Polishing	Cut and polish	—	—	Hand or machine	The colour coat must be thoroughly dry before polishing. After cutting, burnish to a high gloss with a clean mop, and finally clean with a liquid polish, e.g. Apollo liquid polish

NOTE.—(1) For faster drying of undercoats or local repairs G.I.P. thinners 1523 may be used.

(2) Under extreme circumstances of heat and/or humidity retarder G.I.P. Z1694 can be used added to the 2045 M thinners.

(3) For BMC body finishes see BMC Paint Scheme schedules.

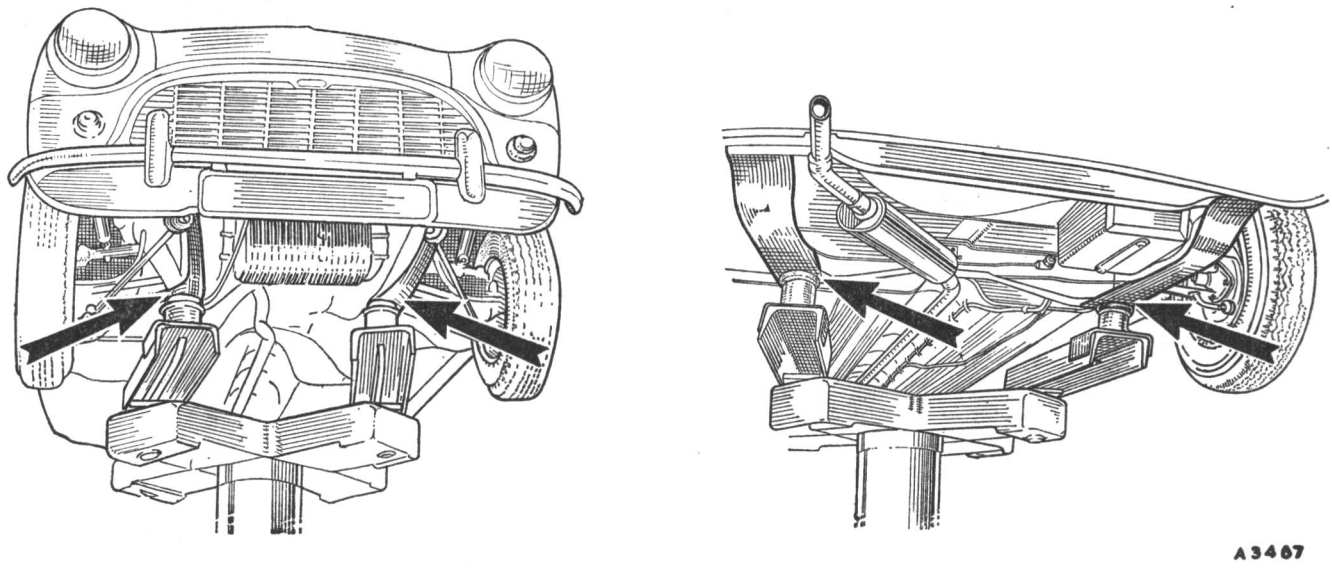


Fig. R.40

When lifting the complete vehicle with the weight taken off the road wheels always place the supports beneath the sub-frame in the positions shown

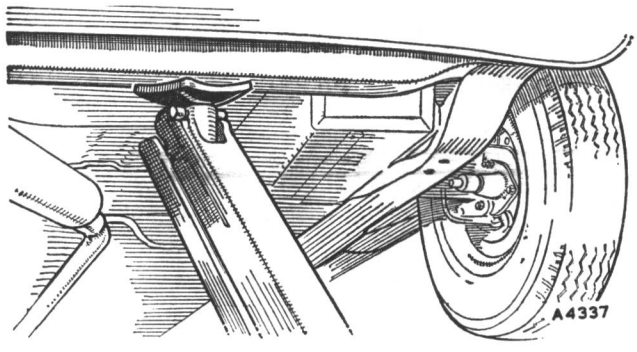


Fig. R.41

The jack pad positioned under the centre of the rear frame cross-member. Models with an underfloor fuel tank have the cross-member forward of the fuel tank

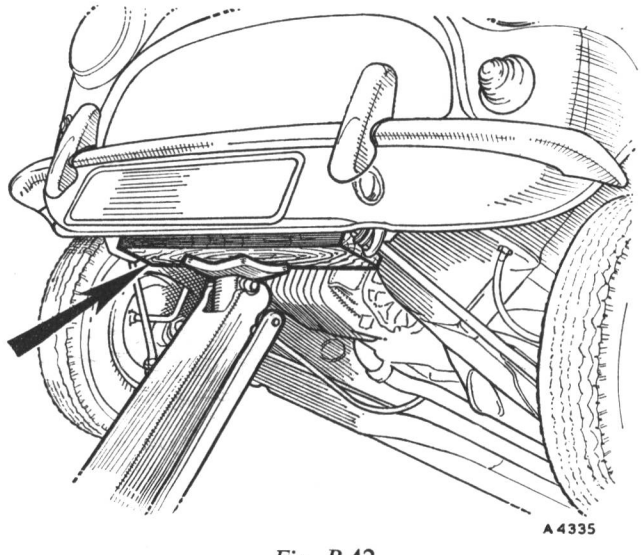


Fig. R.42

The jack positioned under the centre of the front cross-member with shaped wooden block between the jack pad and the cross-member

Section R.34

JACKING

When jacking, using normal workshop jacking and lifting equipment, it is recommended that the jacking points illustrated in Figs. R.40, R.41, and R.42 be used. A specially shaped wooden block can be made to the dimensions given in Fig. R.43 to fit under the front cross-member and give a firm flat surface for jacking purposes.

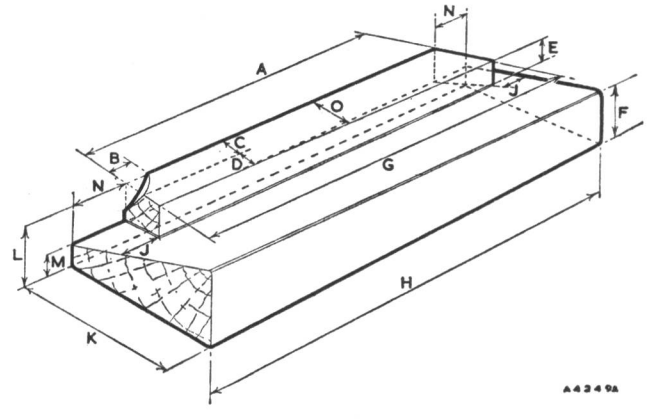


Fig. R.43

The specially shaped wooden block should be made up to the following dimensions

A. 18 13/16 in. (47·76 cm.).
B. 1 1/2 in. (3·8 cm.).
C. 7/8 in. (2·2 cm.).
D. 3/4 in. (1·9 cm.).
E. 7/8 in. (2·2 cm.).
F. 2 5/16 in. (5·8 cm.).
G. 19 3/16 in. (48·74 cm.).
H. 21 3/16 in. (53·8 cm.).
J. 1 in. (2·5 cm.).
K. 4 in. (10·1 cm.).
L. 2 5/16 in. (5·8 cm.).
M. 5/8 in. (1·5 cm.).
N. 1 3/16 in. (3·0 cm.).
O. 1 5/8 in. (4·12 cm.).

Section R.35

WINDSHIELD
(Moke)

Removal

(1) Remove the windshield wiper arm and blade.

(2) Remove four nuts and screws (see Fig. R.44).

(3) Slacken the bottom retaining screws.

(4) Lift the frame and glass from the vehicle.

(5) Remove two screws, detach the bottom channel, and remove the glass from the frame.

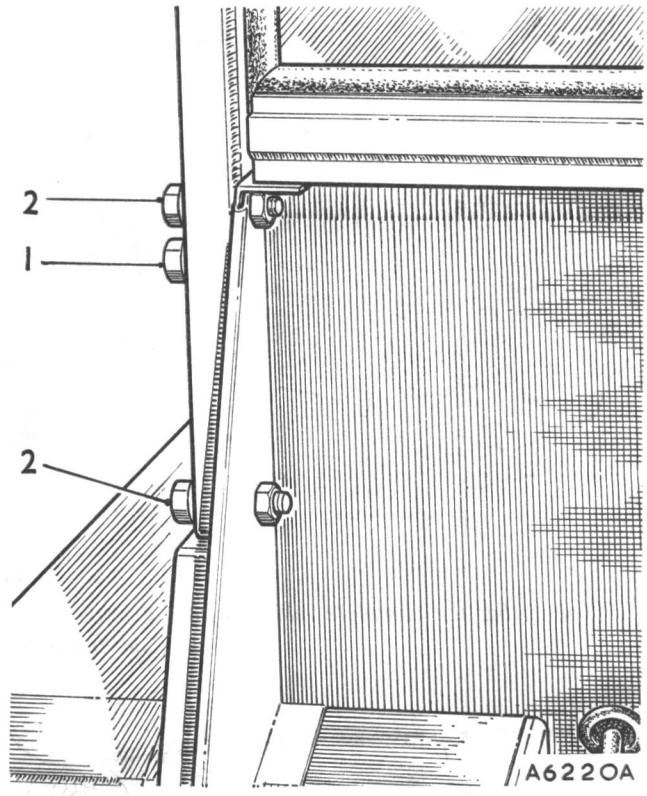


Fig. R.44

The windshield fixing screws

1. Bottom channel to frame.
2. Frame to body.

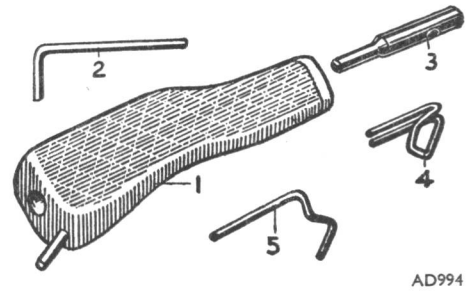
SERVICE TOOLS

18G 468. Rubber Moulding Glazing Tool

For use when fitting the rubber sealing strip to the windshield and rear window mouldings.

The tool comprises:

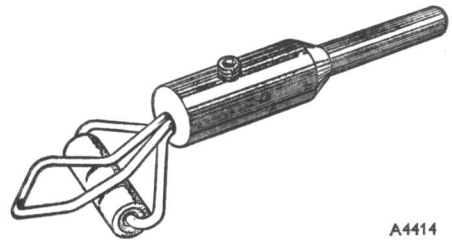
1. Handle.
2. Key.
3. Post.
4. Eye.
5. Hook.



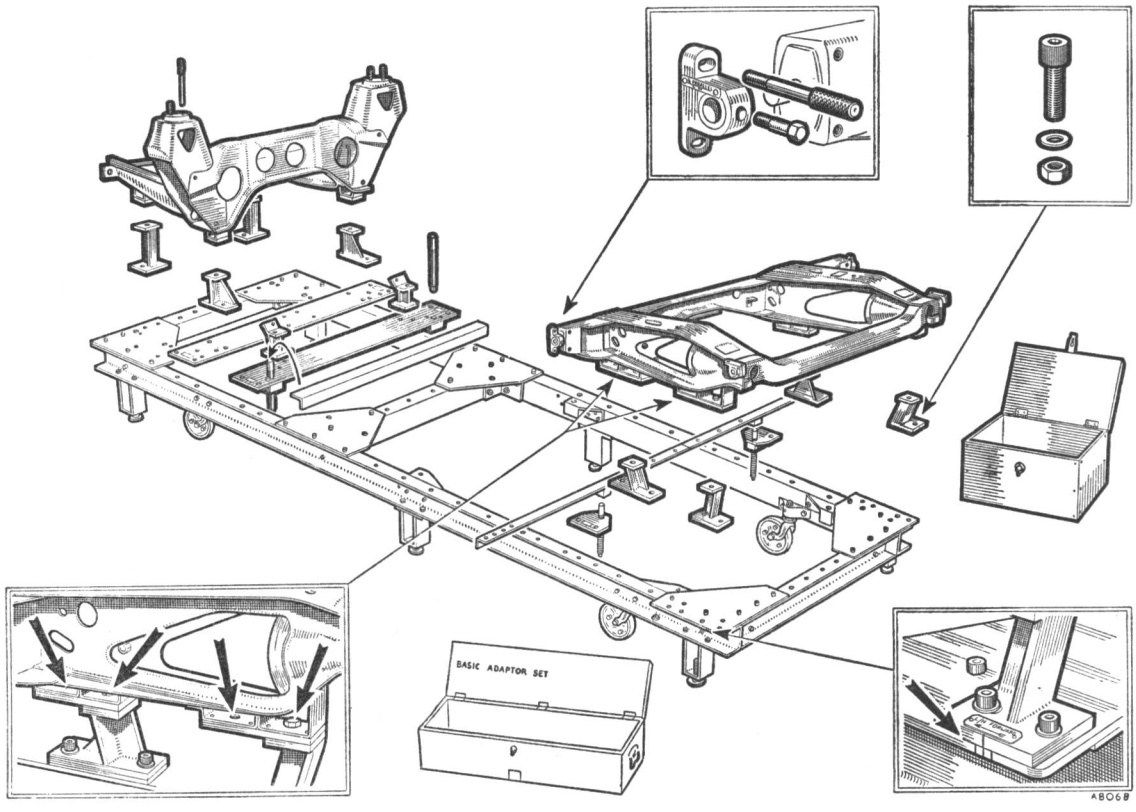
18G 468

18G 468 A. Rubber Moulding Glazing Tool Adaptor

For use with 18G 468.



18G 468 A



18G 560 E

18G 560 E. Body Checking Jig Adaptor Set

For use with basic jig 18G 560 and basic adaptor set 18G 560 A.

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SECTION AA

THE ENGINE

The information given in this Section refers specifically to the Mini-Cooper and must be used in conjunction with Section A

	Section
Camshaft bearings	AA.7
Carburetter removal	AA.2
Cylinder liners	AA.8
Engine removal	
With sub-frame	AA.3
Without sub-frame	AA.1
Exhaust manifold	AA.6
Exhaust pipe assembly	AA.4
Left-hand engine mounting	AA.5
Valve seat inserts	AA.9

Section AA.1

ENGINE REMOVAL
(Without Sub-frame)

The engine can be removed through the bonnet aperture, leaving the sub-frame in the body. This operation is greatly facilitated if a pit is available.

Removing

Disconnect the earth lead from the battery, drain the water from the engine and radiator, and remove the bonnet.

Remove the fresh-air heater motor, if fitted, and disconnect the controls.

Detach the grille by removing its eight retaining screws.

When no pit is available put the rear wheels on blocks, support the body either side near the jacking points at a sufficient height to enable work to be carried out under the car. Put a support under the front of the front sub-frame at its centre. Remove the exhaust pipe and silencer assembly, and the three screws and nuts retaining the gear change extension rear mounting bracket to the floor.

Unscrew the gear lever knob and remove the screws retaining the gear lever rubber cover and plate.

Release the three screws and nuts retaining the mounting bracket to the floor at the rear of the gear change extension (Fig. AA.1).

Remove the four nuts securing the gear change extension to the transmission casing and detach the extension.

Disconnect the heater hoses and the electrical connections on the coil, dynamo, distributor, and temperature gauge element. Remove the starter cable from the starter motor terminal, unscrew the screws retaining the starter solenoid switch bracket to the flywheel housing, and lower the switch complete with cables to the ground clear of the engine.

Disconnect the plug leads from the plugs, the lead from the coil, and remove the distributor cap. Disconnect and remove the horn. Slacken the retaining clip and pull off the rubber oil gauge pipe connector.

Disconnect the accelerator and choke cables and remove the carburetters (Section AA.2).

Remove the screw securing the engine earth strap to the right-hand wing valance, and unscrew and detach the speedometer cable from the back of the instrument.

Release the clutch slave cylinder return spring, unscrew the two slave cylinder securing screws, withdraw the slave cylinder from the push-rod, and secure the cylinder to the engine bulkhead clear of the engine.

Withdraw the right-hand drive shaft as described in Section AA.6 and disconnect the drive shaft from the rubber coupling on the left-hand side.

Remove the screws and nuts retaining the two engine mountings to the sub-frame.

NOTE.—Where a pit is available it will not be necessary to raise the car on supports, but the right-hand side must be supported to withdraw the drive shaft.

Sling the engine at the front to enable it to be tilted backwards when removing. Lift the engine assembly upwards, manœuvring the transmission case and exhaust manifold from under the rear cross-member of the sub-frame.

Replacement is a reversal of the removal procedure.

Section AA.2

CARBURETTER REMOVAL

Remove the bonnet and disconnect the earth terminal from the battery.

Unscrew the four bolts retaining the air cleaners and remove the air cleaners from the carburetters.

Disconnect the accelerator and choke cables from the carburetter linkage. Undo the clip retaining the fuel feed flexible pipe to the carburetter interconnecting pipe and pull off the main flexible pipe.

Remove the screw and nut retaining the interconnecting pipe support clip to the left-hand heat shield.

Unhook the three return springs from their anchorage bracket.

Disconnect the rubber connector for the vacuum ignition control pipe from the right-hand carburetter.

Remove the two nuts and flat washers securing the flange of each carburetter to the inlet manifold and withdraw the carburetters from the studs as one unit.

Replacement is a reversal of the removal procedure.

Check the linkage adjustment after refitting (Section DD.9).

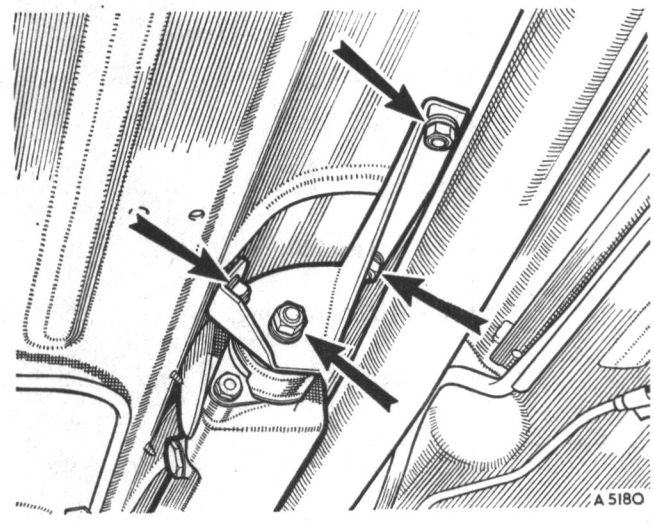


Fig. AA.1

The three mounting bolts for the gearbox extension support bracket. The central arrow indicates the nut securing the bracket to the rubber mounting

Section AA.3

ENGINE REMOVAL
(With Sub-frame)

Disconnect the earth lead from the battery, drain the water from the radiator and cylinder block, and remove the bonnet.

Remove the carburetters (Section AA.2). Disconnect the heater hoses from the tap at the rear of the cylinder

block and the bottom radiator hose. Remove the nut and spring washer securing the heater hose clip to the thermostat housing. Disconnect the wiring from the distributor, coil, dynamo, and temperature gauge element. Pull off the lead terminal from the plugs, disconnect the high-tension lead from the coil, and remove the distributor cap. Unscrew the speedometer cable from the back of the instrument. If a fresh-air heater is fitted, the heater motor, the front grille, and the air intake must be removed.

Remove the starter cable from the terminal on the starter motor, unscrew the two screws securing the starter solenoid switch bracket to the flywheel housing, detach the switch complete with cables, and drop it down through the sub-frame to clear the engine.

Disconnect the hydraulic brake pipe from the top of the intensifier cylinder.

Remove the return spring from the clutch operating arm, unscrew the two screws securing the clutch slave cylinder to the flywheel housing, and secure the slave cylinder to the engine bulkhead. Disconnect the oil gauge pipe at its rubber connector.

Raise the car, remove the front road wheels, disconnect the tie-rod ends from the steering levers, and remove the front hydraulic dampers. Replace the front wheels.

Remove the exhaust system (Section AA.4) and the front carpets.

Release the three screws and nuts retaining the mounting bracket at the rear of the gear change extension (see Fig. AA.1).

Detach the nuts and remove the screws retaining the rear of the front sub-frame to the floor and toeboard. Lower the car, remove the gear lever rubber cover and retaining plate (four screws), unscrew the two screws securing the gear lever retainer to the gear change extension, and withdraw the gear lever.

Remove the two bolts and nuts retaining the front of the sub-frame to the body cross-member, knock back the locking tabs, and unscrew and withdraw the two bolts securing the sub-frame towers to the body on each side.

Where studs are fitted at this location withdraw them to prevent damage and distortion of the studs.

Support the engine and sub-frame assembly and raise the body carefully until the assembly can be wheeled from under the car.

Replacement is the reversal of the removal procedure. The brake system must be bled after the assembly has been reinstalled (see Section MM.3).

Section AA.4

EXHAUST PIPE ASSEMBLY

Removing

Remove the screw securing the exhaust pipe to manifold clamp from the forward end of the gear change extension. Remove the nut and spring washer securing the intermediate exhaust pipe mounting and the two nuts retaining the rear mounting.

Withdraw the assembly from the exhaust manifold.

Replacement is a reversal of the removal procedure.

Section AA.5

LEFT-HAND ENGINE MOUNTING

Removal

Remove the bonnet and front grille.

Remove the top radiator mounting bracket and the two screws retaining the lower radiator bracket to the bottom half of the radiator cowl.

Remove the two screws and nuts securing the engine mounting to the sub-frame.

Detach the two bolts retaining the mounting bracket to the front transmission case and lift the front of the engine.

With the radiator lifted, manœuvre the mounting bracket and rubber mounting assembly forwards and through the grille aperture.

Remove the three screws retaining the rubber mounting to the bracket and detach the mounting.

Reverse the removal procedure to refit.

Section AA.6

EXHAUST MANIFOLD

Removing and replacing

Raise the car and remove the bonnet.

Remove the exhaust pipe and silencer assembly (Section AA.4) and the carburetters (Section AA.2).

Unscrew the manifold retaining nuts and withdraw the inlet manifold off its studs.

Remove the nuts from the two 'U' bolts securing the right-hand universal joint to the differential drive flange and extract the 'U' bolts.

Remove the right-hand front wheel and disconnect the tie-rod end from the steering lever.

Disconnect the top and bottom swivels from the suspension arms and partly withdraw the hub and drive shaft.

Place a support under the hub assembly to prevent damage to the hydraulic hose.

Turn the differential flange until it is upright, withdraw the exhaust manifold from the studs, manœuvre the manifold to the right-hand side until the bottom end will clear the sub-frame and transmission casing, and lift upwards. Replacement is a reversal of the dismantling procedure.

Section AA.7

CAMSHAFT BEARINGS

If the camshaft bearing clearances are excessive new bearings must be fitted. Steel-backed white-metal bearings are used, and removing and refitting are facilitated by the use of the special camshaft liner removing and replacing tool, Service tool 18G 124 A, together with the appropriate adaptors. New bearings must be reamed to give the correct running clearance (see **'GENERAL DATA'**), and the use of the special camshaft liner reamer tools is essential.

Removing the centre liner

Insert the pilot adaptor 18G 124 K into the camshaft liner front bore from the inside of the block and the adaptor 18G 124 B into the centre liner from the rear, small end first.

With the body of the tool positioned on the centre screw, pass the screw through the pilot adaptor and the adaptor in the centre liner.

Place the slotted washer on the flat at the rear of the centre screw and insert the tommy-bar into the screw behind the slotted washer.

Tighten up the wing nut to withdraw the liner.

Removing the front and rear liners

Insert the small end of the adaptor 18G 124 K into the camshaft front liner from the inside of the cylinder block, thread the body of the tool onto the centre screw, and pass the screw through the adaptor from the front of the block. Place the slotted washer on the flat at the rear of the centre-screw and insert the tommy-bar into the centre screw behind the slotted washer.

Tighten up the wing nut to withdraw the worn liner.

The rear liner is withdrawn by the same method, using the adaptor 18G 124 M and withdrawing the liner from the rear of the block.

Replacing camshaft liners

NOTE.—Line up the oil holes in the liners and the cylinder block and make certain that they remain correctly positioned during each operation.

Place the slotted washer on the flat at the rear of the centre screw and insert the tommy-bar into the screw behind the slotted washer.

Tighten the wing nut to pull the liner squarely into position.

The rear liner is replaced by the same method, using the adaptor 18G 124 M and pulling the liner into position from the rear of the block. The 'D' washer **is not** to be used when refitting a rear liner. Adaptor 18G 124 K is positioned in the front liner to act as a pilot.

Centre liner

Insert the pilot adaptor 18G 124 K into the camshaft front liner from the inside of the block.

Place a new liner on the small end of the adaptor 18G 124 B and position the adaptor in the centre liner bore from the rear, largest diameter first.

With the body of the tool positioned on the centre screw insert the screw through the pilot adaptor and the adaptor in the centre liner bore.

Position the larger 'D' washer on the centre screw with the cut-away portion turned away from the butt joints of the liner; this joint must be covered by the washer.

Place the slotted washer and the tommy-bar in the centre screw and tighten up the wing nut to pull the liner into position.

Reaming camshaft liners

IMPORTANT.—It is essential that the cutter flutes are kept clear of swarf at all times during the cutting operations, preferably with air-blast equipment. The cutter should be withdrawn from the liner half-way through the cut and the swarf removed from the cutter and the liner.

Feed the reamer very slowly and keep the cutters dry.

The arbor should be lightly lubricated before assembling the cutters and pilots. All oilways should be thoroughly cleaned when the cutting operations have been completed.

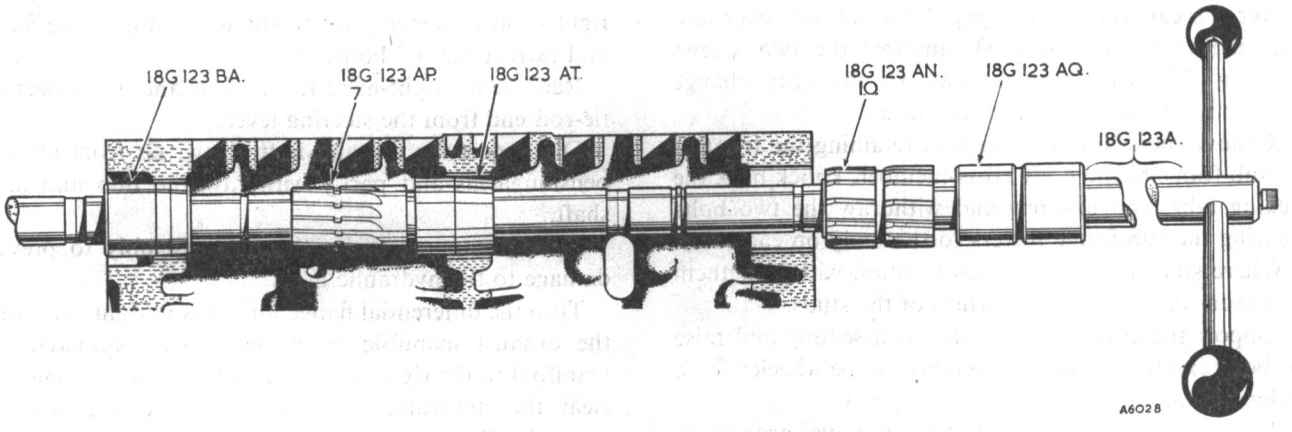


Fig. AA.2

The camshaft reaming tool with the pilots and reamers positioned to ream the front and rear liners

Front and rear liners

Place the new liner on the smallest diameter of the adaptor 18G 124 K and insert the adaptor into the camshaft front liner bore from the inside of the block, largest diameter first.

Thread the body of the tool onto the centre screw and pass the screw through the adaptor located in the front liner from the front of the block.

Position the larger of the two 'D' washers on the centre screw with the cut-away portion turned away from the butt joint of the liner: this joint **must** be covered by the washer.

Front and rear liners

Insert the taper pilots 18G 123 AT and 18G 123 BA into the centre and rear liners respectively.

Place the parallel pilot 18G 123 AQ on the arbor, followed by the cutter 18G 123 AN.

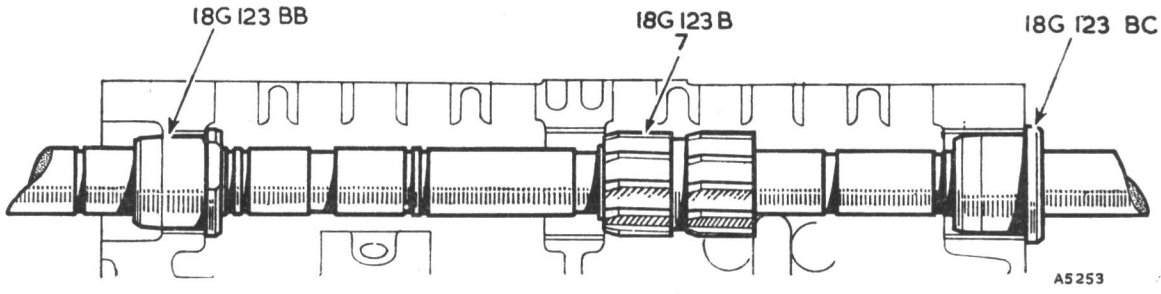


Fig. AA.3

The camshaft liner reamer and pilots in the correct position for reaming the centre liner

Thread the arbor through the front and centre liners, fit the cutter 18G 123 AP on the arbor, and thread the arbor through the taper pilot in the rear liner.

Secure the cutters and pilots in their respective positions; 18G 123 AN is located in No. 10 and 18G 123 AP is located in No. 7 on the arbor.

The cutter for the front liner will be cut first with the arbor piloting in the centre and rear liners. The cutter for the rear liner will follow with the arbor piloting in the front and centre liners. Clear away all the swarf before the plain pilot is allowed to enter the front liner.

When the cut in the rear liner is finished, free the cutters and withdraw the arbor.

Centre liner

Set up for the second part of the operation by inserting the pilots 18G 123 BC and 18G 123 BB in the front and rear liners.

Thread the arbor through the pilot in the front liner and place the cutter 18G 123 B for the centre liner on the arbor. Thread the arbor through the centre liner and the pilot located in the rear liner. Secure the cutter and pilots in position; 18G 123 B is located in No. 7 position on the arbor.

Ream the centre liner, release the cutter, and withdraw the arbor.

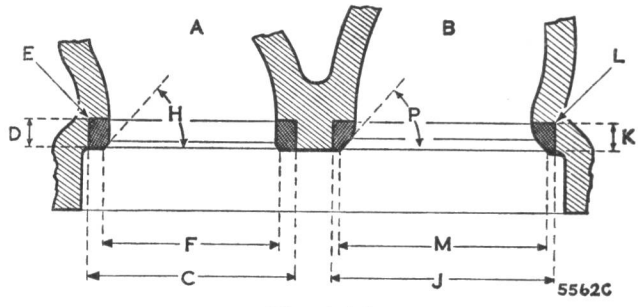


Fig. AA.4

Valve seat machining dimensions

Exhaust (A)

C. 1·124 to 1·125 in. (28·55 to 28·58 mm.).
D. ·186 to ·188 in. (4·72 to 4·77 mm.).
E. Max. radius ·015 in. (·38 mm.).
F. 1·0235 to 1·0435 in. (25·99 to 26·50 mm.).
H. 45°.

Inlet (B) *Cylinder head* 12G 206

J. 1·3075 to 1·3085 in. (33·21 to 33·23 mm.).
K. ·186 to ·188 in. (4·72 to 4·77 mm.).
L. Max. radius ·015 in. (·38 mm.).
M. 1·1435 to 1·1635 in. (29·045 to 29·553 mm.).
P. 45°.

Inlet (B) *Cylinder Head* 12G 295

J. 1·3745 to 1·3755 in. (34·90 to 34·95 mm.).
K. ·186 to ·188 in. (4·70 to 4·75 mm.).
L. Max. radius ·015 in. (·38 mm.).
M. 1·206 to 1·226 in. (30·60 to 31·15 mm.).
P. 45°.

For cylinder liner pilot dimensions, see Fig. AA.5 and its caption.

Section AA.8

CYLINDER LINERS

The instructions for removing and replacing worn liners and for fitting liners to a worn cylinder block are as given in Section A.33. The machining dimensions for the cylinder bores are given in the accompanying table.

Section AA.9

VALVE SEAT INSERTS

Should the valve seatings become so badly worn or pitted that the normal workshop cutting and refacing tools cannot restore them to their original standard of efficiency, special valve seat inserts can be fitted.

Engine type	*Liner Part No.*	*Machine bores of cylinder block to this dimension before fitting liner*	*Outside diameter of liner*	*Interference fit of liner in cylinder block bore*	*Machine liner bore to this dimension after fitting*
997 c.c. (9F)	12A 391	2·6035 to 2·604 in. (66·128 to 66·14 mm.)	2·606 to 2·60675 in. (66·19 to 66·21 mm.)	·002 to ·00325 in. (·05 to ·08 mm.)	2·4570 to 2·4585 in. (62·408 to 62·445 mm.)
998 c.c. (9FA)	12G 164	2·64075 to 2·64125 in. (67·076 to 67·099 mm.)	2·64325 to 2·644 in. (67·139 to 67·158 mm.)	·002 to ·00325 in. (·05 to ·08 mm.)	2·542 to 2·5435 in. (64·571 to 64·608 mm.)

The seatings in the cylinder head must be machined to the dimensions given in Fig. AA.4. Each insert should have an interference fit of ·0025 to ·0045 in. (·063 to ·11 mm.) and must be pressed and not driven into the cylinder head.

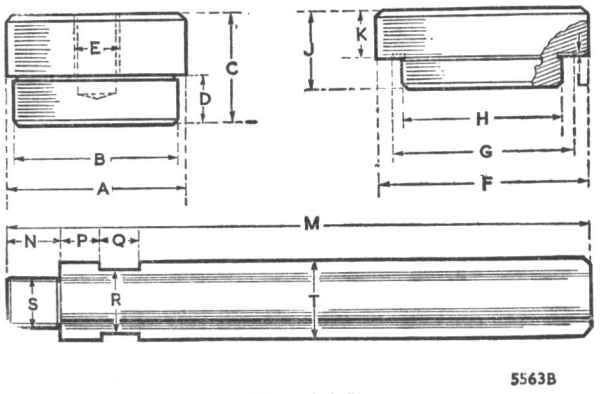


Fig. AA.5

Cylinder liner pilots should be made to the above dimensions from case-hardening steel and case-hardened. The pilot extension should be made from 55-ton hardening and tempering steel, hardened in oil, and then tempered at 550° *C.* (1,020° *F.*)

After fitting, grind or machine the new seating to the dimensions given in Fig. AA.4. Normal valve-grinding may be necessary to ensure efficient valve seating.

Pressing-out pilot

	998 *c.c.*	997 *c.c.*
A.	$2\frac{5}{8}{}^{+\cdot005}_{-\cdot0}$ in. ($66{\cdot}68^{+\cdot127}_{-\cdot0}$ mm.).	$2\frac{19}{32}{}^{+\cdot005}_{-\cdot0}$ in. ($65{\cdot}88^{+\cdot127}_{-\cdot0}$ mm.).
B.	$2{\cdot}537^{+\cdot0}_{-\cdot005}$ in. ($64{\cdot}44^{+\cdot0}_{-\cdot127}$ mm.).	$2{\cdot}452^{+\cdot0}_{-\cdot005}$ in. ($62{\cdot}28^{+\cdot0}_{-\cdot127}$ mm.).
C.	$1\frac{3}{4}$ in. (44·45 mm.).	$1\frac{3}{4}$ in. (44·45 mm.).
D.	$\frac{3}{4}$ in. (19·05 mm.).	$\frac{3}{4}$ in. (19·05 mm.).
E.	$\frac{3}{4}$ in. B.S.W. thread.	$\frac{3}{4}$ in. B.S.W. thread.

Pressing-in pilot

F.	$3\frac{1}{16}$ in. (77·79 mm.).	3 in. (76·20 mm.).
G.	$2\frac{11}{16}$ in. (69·26 mm.).	$2\frac{5}{8}$ in. (66·68 mm.).
H.	$2{\cdot}515^{+\cdot0}_{-\cdot005}$ in. ($63{\cdot}88^{+\cdot0}_{-\cdot127}$ mm.).	$2{\cdot}430^{+\cdot0}_{-\cdot005}$ in. ($61{\cdot}72^{+\cdot0}_{-\cdot127}$ mm.).
J.	$1\frac{1}{4}$ in. (31·75 mm.).	$1\frac{1}{4}$ in. (31·75 mm.).
K.	$\frac{3}{4}$ in. (19·05 mm.).	$\frac{3}{4}$ in. (19·05 mm.).
L.	·015 in. (·38 mm.).	·015 in. (·38 mm.).

Pilot extension

M. $10\frac{1}{2}$ in. (31·75 cm.).
N. $\frac{7}{8}$ in. (22·22 mm.).
P. $\frac{5}{8}$ in. (15·87 mm.).
Q. $\frac{5}{8}$ in. (15·87 mm.).
R. 1 in. (25·4 mm.) flats.
S. $\frac{3}{4}$ in. B.S.W. thread.
T. $1\frac{1}{4}$ in. (31·75 mm.).

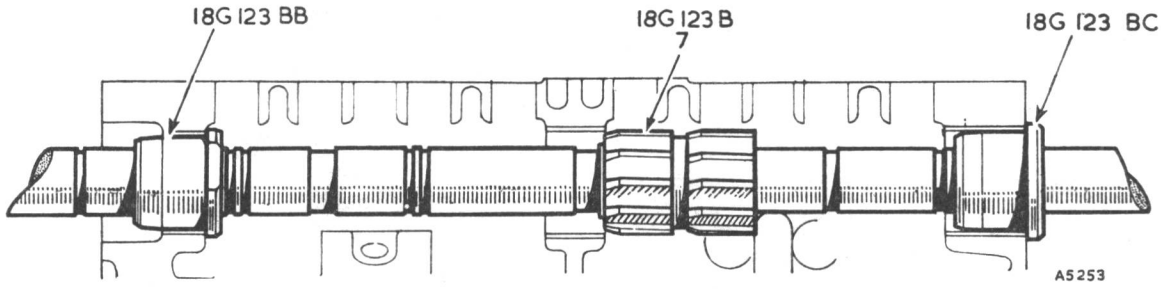


Fig. AA.3

The camshaft liner reamer and pilots in the correct position for reaming the centre liner

Thread the arbor through the front and centre liners, fit the cutter 18G 123 AP on the arbor, and thread the arbor through the taper pilot in the rear liner.

Secure the cutters and pilots in their respective positions; 18G 123 AN is located in No. 10 and 18G 123 AP is located in No. 7 on the arbor.

The cutter for the front liner will be cut first with the arbor piloting in the centre and rear liners. The cutter for the rear liner will follow with the arbor piloting in the front and centre liners. Clear away all the swarf before the plain pilot is allowed to enter the front liner.

When the cut in the rear liner is finished, free the cutters and withdraw the arbor.

Centre liner

Set up for the second part of the operation by inserting the pilots 18G 123 BC and 18G 123 BB in the front and rear liners.

Thread the arbor through the pilot in the front liner and place the cutter 18G 123 B for the centre liner on the arbor. Thread the arbor through the centre liner and the pilot located in the rear liner. Secure the cutter and pilots in position; 18G 123 B is located in No. 7 position on the arbor.

Ream the centre liner, release the cutter, and withdraw the arbor.

Section AA.8

CYLINDER LINERS

The instructions for removing and replacing worn liners and for fitting liners to a worn cylinder block are as given in Section A.33. The machining dimensions for the cylinder bores are given in the accompanying table.

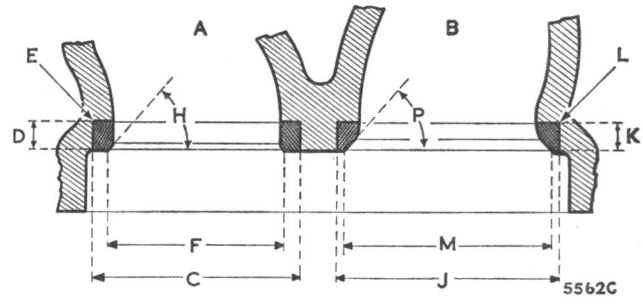


Fig. AA.4

Valve seat machining dimensions

Exhaust (A)	*Inlet* (B)
C. 1·124 to 1·125 in. (28·55 to 28·58 mm.).	J. 1·3075 to 1·3085 in. (33·21 to 33·23 mm.).
D. ·186 to ·188 in. (4·72 to 4·77 mm.).	K. ·186 to ·188 in. (4·72 to 4·77 mm.).
E. Max. radius ·015 in. (·38 mm.).	L. Max. radius ·015 in. (·38 mm.).
F. 1·0235 to 1·0435 in. (25·99 to 26·50 mm.).	M. 1·1435 to 1·1635 in. (29·045 to 29·553 mm.).
H. 45°.	P. 45°.

For cylinder liner pilot dimensions, see Fig. AA.5 and its caption.

Section AA.9

VALVE SEAT INSERTS

Should the valve seatings become so badly worn or pitted that the normal workshop cutting and refacing tools cannot restore them to their original standard of efficiency, special valve seat inserts can be fitted.

The seatings in the cylinder head must be machined to the dimensions given in Fig. AA.4. Each insert should

Engine type	*Liner Part No.*	*Machine bores of cylinder block to this dimension before fitting liner*	*Outside diameter of liner*	*Interference fit of liner in cylinder block bore*	*Machine liner bore to this dimension after fitting*
997 c.c. (9F)	12A 391	2·6035 to 2·604 in. (66·128 to 66·14 mm.)	2·606 to 2·60675 in. (66·19 to 66·21 mm.)	·002 to ·00325 in. (·05 to ·08 mm.)	2·4570 to 2·4585 in. (62·408 to 62·445 mm.)
998 c.c. (9FA)	12G 164	2·64075 to 2·64125 in. (67·076 to 67·099 mm.)	2·64325 to 2·644 in. (67·139 to 67·158 mm.)	·002 to ·00325 in. (·05 to ·08 mm.)	2·542 to 2·5435 in. (64·571 to 64·608 mm.)

have an interference fit of ·0025 to ·0045 in. (·063 to ·11 mm.) and must be pressed and not driven into the cylinder head.

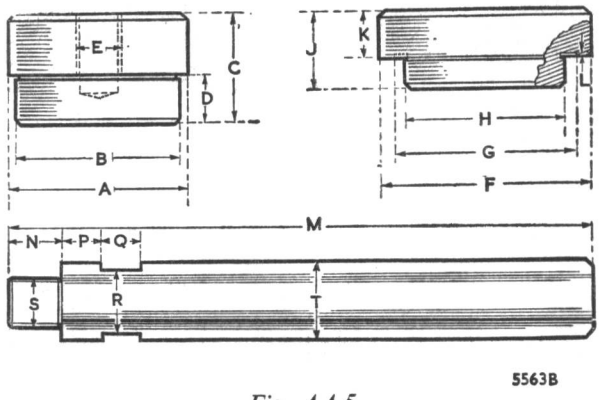


Fig. AA.5

Cylinder liner pilots should be made to the above dimensions from case-hardening steel and case-hardened. The pilot extension should be made from 55-ton hardening and tempering steel, hardened in oil, and then tempered at 550° *C.* (1,020° *F.*)

After fitting, grind or machine the new seating to the dimensions given in Fig. AA.4. Normal valve-grinding may be necessary to ensure efficient valve seating.

Pressing-out pilot

	998 *c.c.*	997 *c.c.*
A.	$2\frac{5}{8}{}^{+\cdot005}_{-\cdot0}$ in. (66·68$^{+\cdot127}_{-\cdot0}$ mm.).	$2\frac{18}{32}{}^{+\cdot005}_{-\cdot0}$ in. (65·88$^{+\cdot127}_{-\cdot0}$ mm.).
B.	2·537$^{+\cdot0}_{-\cdot005}$ in. (64·44$^{+\cdot0}_{-\cdot127}$ mm.).	2·452$^{+\cdot0}_{-\cdot005}$ in. (62·28$^{+\cdot0}_{-\cdot127}$ mm.).
C.	$1\frac{3}{4}$ in. (44·45 mm.).	$1\frac{3}{4}$ in. (44·45 mm.).
D.	$\frac{3}{4}$ in. (19·05 mm.).	$\frac{3}{4}$ in. (19·05 mm.).
E.	$\frac{3}{4}$ in. B.S.W. thread.	$\frac{3}{4}$ in. B.S.W. thread.

Pressing-in pilot

F.	$3\frac{1}{16}$ in. (77·79 mm.).	3 in. (76·20 mm.).
G.	$2\frac{11}{16}$ in. (69·26 mm.).	$2\frac{5}{8}$ in. (66·68 mm.).
H.	2·515$^{+\cdot0}_{-\cdot005}$ in. (63·88$^{+\cdot0}_{-\cdot127}$ mm.).	2·430$^{+\cdot0}_{-\cdot005}$ in. (61·72$^{+\cdot0}_{-\cdot127}$ mm.).
J.	$1\frac{1}{4}$ in. (31·75 mm.).	$1\frac{1}{4}$ in. (31·75 mm.).
K.	$\frac{3}{4}$ in. (19·05 mm.).	$\frac{3}{4}$ in. (19·05 mm.).
L.	·015 in. (·38 mm.).	·015 in. (·38 mm.).

Pilot extension

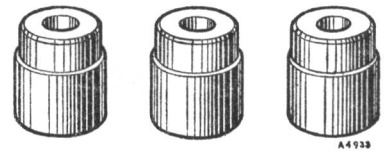
M. $10\frac{1}{2}$ in. (31·75 cm.).
N. $\frac{7}{8}$ in. (22·22 mm.).
P. $\frac{5}{8}$ in. (15·87 mm.).
Q. $\frac{5}{8}$ in. (15·87 mm.).
R. 1 in. (25·4 mm.) flats.
S. $\frac{3}{4}$ in. B.S.W. thread.
T. $1\frac{1}{4}$ in. (31·75 mm.).

SERVICE TOOLS

18G 124 K, 18G 124 B, 18G 124 M. Camshaft Liner Remover Adaptors

For use with Service tool 18G 124 A when removing and replacing camshaft liners.

These tools are essential to prevent the damage to liners and housings which invariably occurs when improvised methods are used.



18G 124 K, 18G 124 B, 18G 124 M

18G 123 BA, 18G 123 AT. Taper Pilots

For use when reaming front and rear liners.

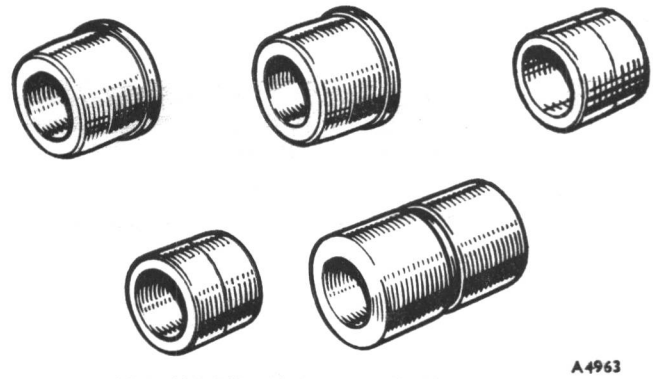
18G 123 AQ. Parallel Pilot

For use when reaming the rear camshaft liner.

18G 123 BB, 18G 123 BC. Taper Pilots

For use when reaming the centre camshaft liners.

All the above pilots are for use in conjunction with Service tool 18G 123 A.



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18G 123 BB, 18G 123 BC, 18G 123 AT, 18G 123 BA, 18G 123 AQ

18G 123 AP. Camshaft Liner Reamer Cutter

For use when reaming the rear camshaft liner.

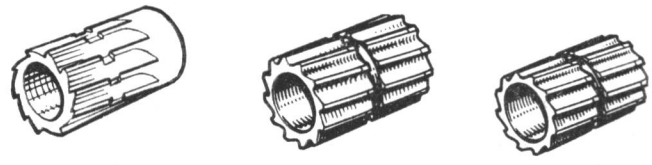
18G 123 AN. Camshaft Liner Reamer Cutter

For use when reaming the front camshaft liner.

18G 123 B. Camshaft Liner Reamer Cutter

For use when reaming the centre camshaft liner.

All the above cutters are for use in conjunction with Service tool 18G 123 A.



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18G 123 AP, 18G 123 AN, 18G 123 B

SECTION AAA

THE ENGINE

The information given in this Section refers specifically to the Mini-Cooper 'S' and must be used in conjunction with Sections A and AA

	Section
Cylinder head	AAA.3
Engine—removing	AAA.1
Pistons and connecting rods	AAA.2
Valves	AAA.4

Section AAA.1

REMOVING THE ENGINE

When removing the engine as described in Sections AA.1 and AA.3 the following additional operations will be necessary.

When removing the engine with the sub-frame it will be necessary to disconnect the vacuum pipe from the inlet manifold. Where the engine is removed without the sub-frame, remove the heater air intake hose and then remove the servo unit after first disconnecting the vacuum and hydraulic pipes.

Mark the pin and piston before dismantling to ensure that the pin is replaced in the same side of the piston from which it was removed.

Removal

Hold the hexagonal body of Service tool 18G 1002 in a vice with the cut-out (10) uppermost as shown in Fig. AAA.1. The cut-out gives a clearance for the piston rings to prevent accidental damage. Screw the large nut (1) back until it is flush with the end of the centre screw (9), then push the centre screw and nut forward until the nut makes contact with the thrust race (2). This is to

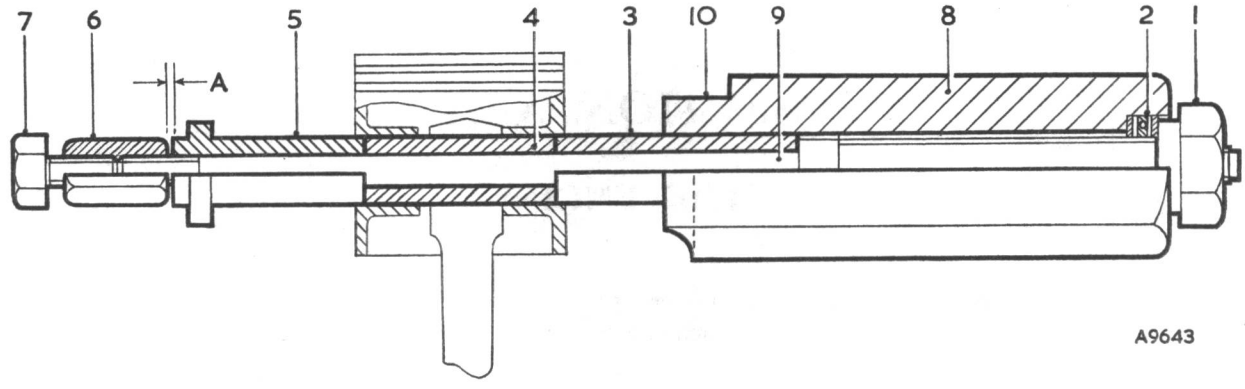


Fig. AAA.1

Service tool 18G 1002 *in position to remove the gudgeon pin*

1. Nut.
2. Thrust race.
3. Parallel sleeve.
4. Gudgeon pin.
5. Remover/replacer bush.
6. Stop nut.
7. Lock screw.
8. Body.
9. Centre screw.
10. Piston ring cut-out.

A = $\frac{1}{32}$ in. (·8 mm.).

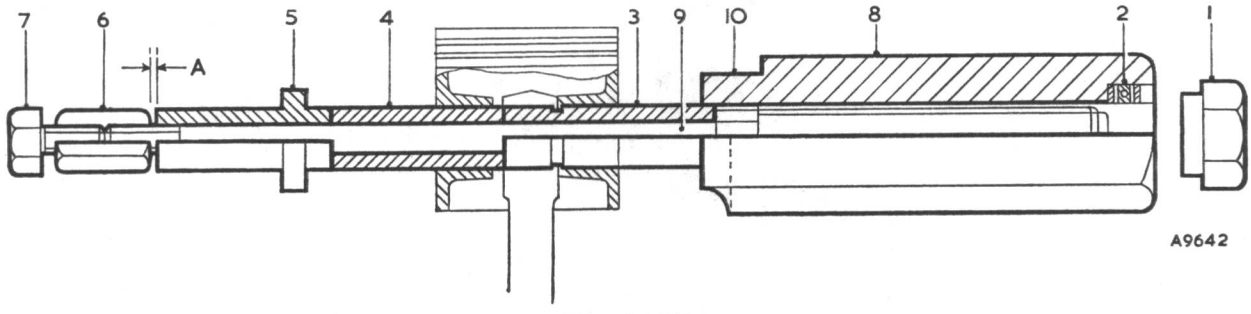


Fig. AAA.2

Service tool 18G 1002 *in position to refit the gudgeon pin*

Section AAA.2

PISTONS AND CONNECTING RODS

The gudgeon pin is a press fit in the small-end of the connecting rod, and the bearing surfaces for the pin are in the piston bosses. The interference fit of the pin in the small-end is the only method used to retain the gudgeon pin in its correct relative position. It is therefore essential that the specified interference fit is maintained (see **'GENERAL DATA'**). Service tool 18G 1002 must be used to remove and replace the gudgeon pin, and great care is necessary when carrying out this operation to avoid crushing or distorting the piston.

prevent accidental damage to the piston when assembling the remainder of the tool. Slide the parallel sleeve (3), the short length diameter first, onto the centre screw up to the shoulder. Place the piston and connecting rod assembly onto the centre screw as shown, then fit the remover/replacer bush (5) over the centre screw with the longest diameter portion towards the piston assembly. Screw the stop nut (6) onto the end of the centre screw and adjust until there is approximately $\frac{1}{32}$ in. (·8 mm.) end-play in the whole assembly. Ensure that the parallel sleeve and remover/replacer bush are locating correctly and fully in the gudgeon pin bores on both sides of the piston. Screw the lock screw (7) into the stop nut and lock the stop nut securely in position. Make sure that

the curved face of the hexagonal body is clean, and then carefully push the piston assembly into position against the curved face. Ensure that the piston rings are over the cut-out. Screw the large nut (1) up to the thrust race (2). Hold the lock screw (7) with a suitable spanner, **not the stop nut** (6), then using the correct size ring or open spanner turn the large nut (1) until the gudgeon pin (4) is withdrawn from the piston assembly.

Replacing

To avoid accidental damage to the piston remove the large nut (1) from the centre screw (9) and pull the screw out from the hexagonal body a few inches as shown in Fig. AAA.2. Slide the parallel sleeve (3), longest length diameter portion first on to the centre screw up to the shoulder. Place the connecting rod in the piston, and pass the connecting rod and piston over the centre screw and parallel sleeve, ensuring that the short length diameter of the sleeve enters the connecting rod small end up to the undercut on the sleeve (see Fig. AAA.1).

Smear the gudgeon pin (4) with thin oil, slide it over the centre screw and through the bore in the piston until it abuts against the face of the connecting rod. Fit the remover/replacer bush (5) over the centre screw with the shortest diameter portion towards the gudgeon pin. Fit the stop nut (6), adjust to give $\frac{1}{32}$ in. (·8 mm.) end-play, and securely lock the stop nut in this position with the lock screw (7).

Ensure that the curved face of the hexagonal body is clean and push the piston against the face, making sure that the piston rings, if fitted, are over the cut-out provided. Screw the large nut back onto the centre screw. Set the torque wrench to 16 lb. ft. (2·21 kg. m.), which represents the minimum load for an acceptable interference fit of the gudgeon pin in the small end of the connecting rod.

Using Service tool 18G 587 with the torque wrench and holding the stop nut screw with a suitable spanner, turn the large nut (1) to pull the gudgeon pin into the connecting rod small end until the flange on the remover/replacer bush (5) is $\frac{1}{32}$ in. (·8 mm.) from the face of the piston. Under no circumstances must this flange be allowed to contact the piston face.

If the torque wrench has not broken throughout the operation, the fit of the gudgeon pin in the connecting rod is **not** acceptable, and the connecting rod and piston assembly must not be fitted to the engine under these conditions.

The large nut (1) and the centre screw (9) must be kept well lubricated with thin engine oil at all times to prevent wear, and to avoid excessive friction giving a false torque wrench reaction.

Lubricate the gudgeon pin with Acheson's Colloids 'oil dag' before refitting it to the piston and connecting rod.

After refitting, check that the piston pivots freely on the pin, and is also free to slide sideways. Should this not be so, wash the assembly in fuel or paraffin (kerosene), lubricate the gudgeon pin with neat 'oil dag', and re-check. If stiffness still persists, dismantle the assembly and check for ingrained dirt or damage. When the assembly is satisfactory, check the piston and connecting rod for alignment before fitting to the engine.

Section AAA.3

CYLINDER HEAD

The cylinder head is secured to the cylinder block by 10 nuts and one bolt. The 10 nuts must be tightened in the normal sequence and to the specified torque (see **'GENERAL DATA'**).

The one bolt, situated at the front of the cylinder head, must be tightened last, and under no circumstances must the specified tightness for this bolt be exceeded. Overtightening will result in damage to the bolt and its thread insert in the cylinder block. Apart from its location, this bolt can be identified by the figures '300' stamped on the head of the bolt.

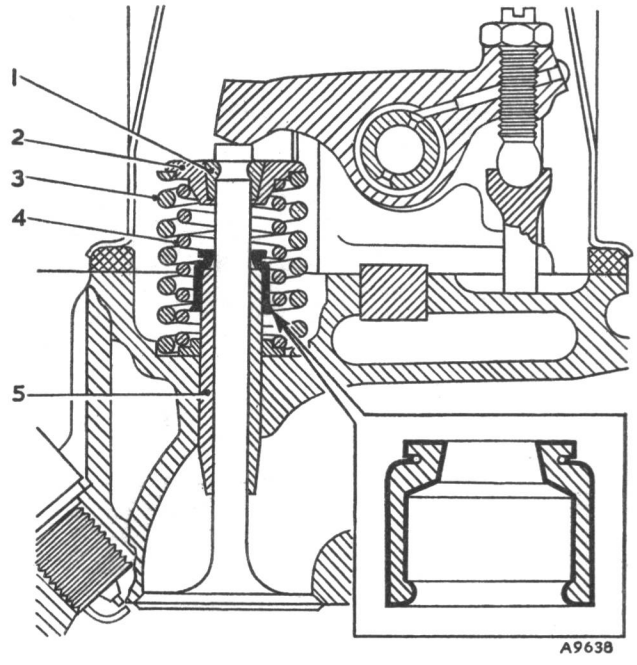


Fig. AAA.3

The valve components assembled. (The valve oil seal is shown inset)

1. Split cotters.
2. Retaining cup.
3. Outer spring.
4. Inner spring.
5. Valve guide.

Section AAA.4

VALVES

Removing

Remove the cylinder head as detailed in Section A.9.

Before removing the valves stamp the head of each valve with a number to indicate the position to which it must be returned. Commence with No. 1 at the front of the engine.

Compress the valve springs with a special valve spring compressor, and remove the split cotters.

Release the valve springs and remove the compressor. Remove the retaining cap and valve springs, and rubber seal. Withdraw the valve from the guide.

Keep the valves in their relative positions when removed from the cylinder head to ensure replacement in their original valve guides. The exhaust valve heads are smaller than the inlet valves.

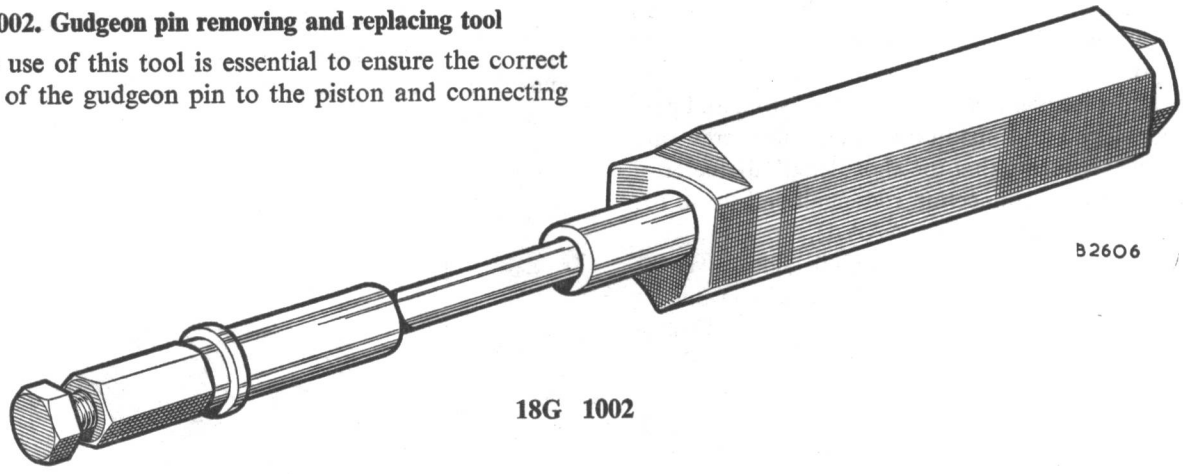
Refitting

Fit a new oil seal to the valve guide (see Fig. AAA.3) and place each valve in its respective guide. Ensure that the register for the inner spring is in position on the cylinder head. Refit the inner and outer valve springs and cotter retaining cup. Compress the springs, fit the split cotters, and release the compressing tool.

SERVICE TOOLS

18G 1002. Gudgeon pin removing and replacing tool

The use of this tool is essential to ensure the correct fitting of the gudgeon pin to the piston and connecting rod.



18G 1002

SECTION BBB

THE IGNITION SYSTEM

The information given in this Section refers specifically to the Mini-Cooper 'S' and must be used in conjunction with Section B

	Section
Distributor	BBB.1

Section BBB.1

DISTRIBUTOR

The information given in Section B.6 applies to the Mini-Cooper 'S', with the exception that there is no vacuum unit fitted to the distributor. Any final adjustment to ignition setting must be done by slackening the clamp bolt and turning the distributor body.

The correct static ignition timing is given in **'GENERAL DATA'.**

SECTION CC

THE COOLING SYSTEM

The information given in this Section refers specifically to the Mini-Cooper and must be used in conjunction with Section C

	Section
Fan belt removal	CC.2
Modified thermostat	CC.3
Radiator	CC.1

Section CC.1

RADIATOR

Removing and refitting

Mark the position of the bonnet hinges, remove the four securing bolts, and lift off the bonnet.

Unscrew the eight Phillips screws retaining the front grille and detach the grille.

Release the hose clip retaining the top hose to the radiator and pull off the hose.

Remove the screws retaining the top radiator mounting bracket to the thermostat housing and the radiator top tank and detach the bracket.

Unscrew the two screws on each side retaining the top half of the radiator cowl to the radiator and lift off the cowl.

Release the bottom radiator mounting bracket by removing the two securing screws in the bottom half of the cowl.

Disconnect the bottom hose from the engine, and the heater hose from its take-off in the bottom hose.

Hold the radiator forward against the valance, remove the four screws retaining the fan, and extract the fan.

Lift out the radiator.

To refit the radiator reverse the removal procedure.

Section CC.2

FAN BELT

Removing and refitting

Take out the eight screws and remove the front grille.

Drain the radiator and remove the top hose.

Remove the two nuts and spring washers retaining the top radiator bracket to the thermostat housing, the two hexagon screws retaining the bracket to the top radiator cowl, and remove the bracket. Take out the two screws either side of the radiator retaining the top half of the cowl and remove the cowl.

Remove the two screws retaining the bottom radiator mounting bracket to the bottom half of the cowl. This will release the radiator and give clearance to allow the fan belt to be withdrawn.

Slacken the dynamo mounting bolts, remove the fan belt from the engine and dynamo pulleys, and manœuvre the belt under the crankshaft damper, in front of the fan blades, and remove upwards.

Refitting is a reversal of the removal procedure.

Section CC.3

MODIFIED THERMOSTAT

From Engine No. 9F–SA–H–4167 a modified non-bellows-type thermostat was fitted, together with a modified water outlet. When refitting this type of thermostat it is essential that the threaded stem of the thermostat faces upwards.

SECTION DD

THE FUEL SYSTEM

The information given in this Section refers specifically to the Mini-Cooper and must be used in conjunction with Section D

	Section
Carburetters	DD.1
Air cleaners	DD.5
Dampers	DD.4
Float-chamber removal	DD.3
Linkage adjustment	DD.2

Section DD.1

CARBURETTERS

Slow-running adjustment and synchronization

After the first 1,000 miles (1600 km.) or so, when the engine is fully run in, the slow-running may require adjustment. This must only be carried out when the engine has reached its normal running temperature.

As the needle size is determined during engine development, tuning of the carburetters is confined to correct idling setting. Slacken the actuating arms on the throttle spindle interconnection. Close each throttle fully by unscrewing the throttle adjusting screws, then open each throttle by screwing down the idling adjustment screws one turn.

Remove the pistons and suction chambers and disconnect the jet control cables. Screw the jet adjusting nuts until each jet is flush with the bridge of its carburetter, or as near to this as possible (each jet being in the same relative position to the bridge of its respective carburetter). Replace the pistons and suction chamber assemblies and check that the pistons fall freely onto the bridge of the carburetters (by use of the piston lifting pins). Turn down the jet adjusting nut two complete turns (12 flats).

Restart the engine and adjust the throttle adjusting screws to give the desired idling speed by moving each throttle adjusting screw an equal amount. By listening to the hiss in the intake, adjust the throttle adjusting screws until the intensity of the hiss is similar on each intake. This will synchronize the throttle setting.

When this is satisfactory the mixture should be adjusted by screwing each jet adjusting nut up or down by the same amount until the fastest idling speed is obtained consistent with even firing. During this adjusting it is necessary that the jets are pressed upwards to ensure that they are in contact with the adjusting nuts.

As the mixture is adjusted the engine will probably run faster, and it may therefore be necessary to unscrew the throttle adjusting screws a little, each by the same amount, to reduce the speed.

Now check the mixture strength by lifting the piston of the left-hand carburetter by approximately $\frac{1}{32}$ in. (·75 mm.), when:

(1) If the engine speed increases, the mixture strength of the left-hand carburetter is too rich.

(2) If the engine speed immediately decreases, the mixture strength of the left-hand carburetter is too weak.

(3) If the engine speed momentarily increases very slightly, the mixture strength of the left-hand carburetter is correct.

Repeat the operation at the right-hand carburetter, and after adjustment re-check the left-hand carburetter, since both carburetters are interdependent.

When the mixture is correct the exhaust note should be regular and even. If it is irregular, with a splashy type of misfire and colourless exhaust, the mixture is too weak. If there is a regular or rhythmical type of misfire in the exhaust beat, together with a blackish exhaust, then the mixture is too rich.

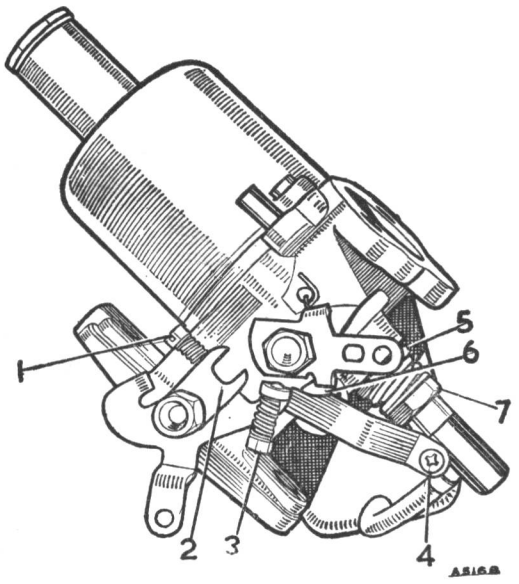


Fig. DD.1

The HS2 carburetter

1. Throttle adjusting screw.
2. Butterfly operating fork.
3. Fast-idle adjusting screw.
4. Jet link securing screw.
5. Jet locking nut.
6. Float-chamber securing bolt.
7. Jet adjusting nut.

Section DD.2

LINKAGE ADJUSTMENT

The carburetter throttle on each carburetter is operated by a lever and pin, with the pin working in a forked lever attached to the throttle spindle. A clearance exists between the pin and the fork which must be maintained when the throttle is closed and the engine idling to prevent any load from the accelerator linkage being transferred to the throttle butterfly and spindle.

To set this clearance: with the throttle shaft levers free on the throttle shaft, put a ·012 in. (·305 mm.) feeler between the throttle shaft stop and the choke interconnecting spindle (see Fig. DD.2). Move each throttle shaft lever downwards in turn until the lever pin rests lightly on the lower arm of the fork in the carburetter throttle lever. Tighten the clamp bolt of the throttle shaft lever at this position. When both carburetters have been dealt with, remove the feeler. The pins on the throttle shaft levers should then have clearance in the forks.

Reconnect the choke cable, ensuring that the jet heads return against the lower face of the jet adjusting nuts when the choke control is pushed fully in.

Pull out the mixture control knob on the dash panel to its maximum movement without moving the carburetter jets (about $\frac{5}{8}$ in. [15·87 mm.]), and adjust the fast-idle cam screws to give an engine speed of about 1,000 r.p.m. when hot.

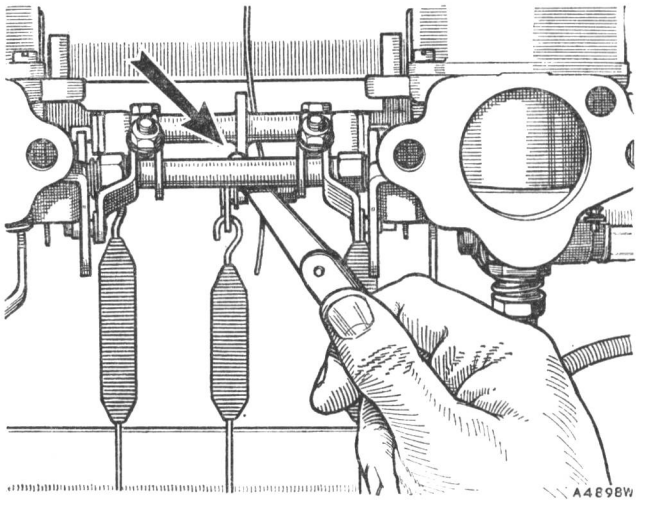


Fig. DD.2

The feeler between the throttle shaft stop and the choke interconnecting spindle

Section DD.3

FLOAT-CHAMBER REMOVAL

Remove the air cleaners, slacken the clip securing the flexible fuel pipe to the float-chamber inlet pipe, and pull off the pipe. Remove the Phillips screw retaining the jet operating link to the jet head. Support the opposite side of the jet head whilst removing the screw to prevent damage to the jet head. Swing the jet link to clear the float-chamber securing bolts, and, using a short $\frac{7}{16}$ in. A.F. spanner, remove the bolt. Unscrew the union nut retaining the feed tube to the base of the float-chamber and detach the float-chamber.

Refitting is a reversal of the removal procedure.

Do not completely tighten the feed tube retaining nut until the float-chamber is in its correct position on the carburetter body to ensure a neutral run of the feed tube.

Section DD.4

CARBURETTER DAMPERS

It is most important that only the correct type of dampers are used. Use thin engine oil to Ref. D. (End of manual) to lubricate the piston dampers. Maintain the oil level to within ·5 in. (13 mm.) of the top of the hollow piston rods. Under no circumstances should a heavy bodied lubricant be used. Failure to lubricate the piston dampers will cause the pistons to flutter and reduce acceleration.

Lubrication should be carried out at the periods stated in the Passport to Service or Driver's Handbook.

Section DD.5

CARBURETTER AIR CLEANERS

The air cleaners are of the oil-wetted gauze type and should be removed for cleaning and re-oiling at the periods stated in the Passport to Service or Driver's Handbook.

Removal

Detach the breather hose and remove the four retaining screws (Fig. DD.3) to remove the air cleaners.

Cleaning

Wash the gauzes thoroughly in fuel, dry, and re-oil with oil to Ref. D (End of Manual).

Refitting

Reverse the removal procedure, fitting new joint washers if necessary.

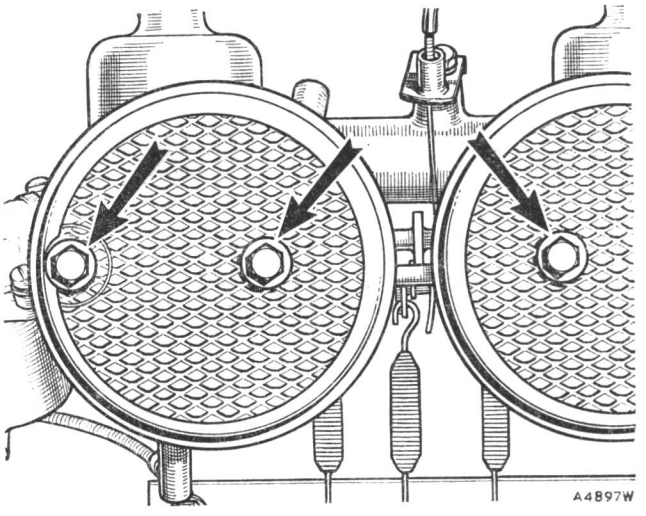


Fig. DD.3

The carburetter air cleaners, indicating three of the four retaining screws

SECTION FFF

THE TRANSMISSION

The information given in this Section refers specifically to the Mini-Cooper 'S' and must be used in conjunction with Section F

	Section
Needle-roller bearings	FFF.1

Section FFF.1

NEEDLE-ROLLER BEARINGS

The layshaft is fitted with caged-type needle-roller bearings. This also applies to the third motion shaft spigot bearing in the first motion shaft. The idler gear shaft needle-roller bearings are also of the caged type, but run in steel cases because their housings are aluminium.

The second and third speed gears are fitted with needle-roller bearings (26 for each gear). The third motion shaft has a built-in spacer for the needle-roller bearings, a locking collar for each gear, and a washer for the second speed gear collar. The third gear collar is locked by a single peg and spring, and the second gear collar by two pegs acting at opposite ends of one spring.

SECTION JJ

THE STEERING GEAR

The information given in this Section refers specifically to the Mini-Cooper and must be used in conjunction with Section J

	Section
Steering-rack	JJ.1

Section JJ.1

STEERING-RACK

Removing

Jack up the car under the sub-frame and remove the front wheels.

Disconnect the track-rod ends from the steering levers and disconnect and remove the hydraulic dampers.

Remove the four screws and nuts securing the rear of the front sub-frame to the floor of the body.

From inside the car remove the bolt and nut clamping the bottom of the inner steering-column to the pinion shaft.

Mark the lower edge of the steering-column shroud and the steering-column clamp bracket to enable them to be lined up on reassembly.

Slacken the bolt clamping the steering-column to the parcel shelf bracket and lift the column assembly until the lower end of the inner column is clear of the splined end of the pinion shaft.

Remove the air cleaners from the carburetters.

Remove the exhaust pipe and silencer assembly (Section AA.4) and remove the three nuts and screws retaining the gear lever extension to the floor.

Tap back the lock washers and remove the four bolts (two each side) retaining the sub-frame towers to the body. In cases where studs are fitted at this location the studs must be withdrawn to avoid damage to the threads or distortion of the studs.

Slacken and remove the four nuts retaining the two rack 'U' bolts to the floor.

Slacken the front sub-frame mounting bolts.

Support the body and lower the jack: the sub-frame will then drop down from the body, giving clearance to remove the 'U' bolts.

Should it be necessary to prise the sub-frame down farther, use a lever between the top of each tower and the wing valance.

Remove the rack from the driver's side.

Dismantling

For dismantling, and for adjustments to the rack assembly see, Section J.3.

Reassembling and refitting

Centralize the rack and mark the pinion so that the position of the rack can be checked after the assembly has been fitted to the car.

On later models a line is stamped on the end of the pinion shaft; assemble with the stamped line vertical and below the horizontal centre-line of the column for a right-hand-drive vehicle and above the horizontal centre-line for a left-hand-drive vehicle. The full travel of the rack from stop to stop is 3·5 in. (89 mm.), 1·75 in. (44·5 mm.) in each direction.

Two-and-one-third turns of the pinion will give complete travel of the steering rack from stop to stop.

Refit the rack to the car, insert the 'U' bolts, but do not fully tighten the nuts.

Centralize the pinion shaft in the hole in the toeboard.

Slacken the screws retaining the steering-column bracket to the parcel shelf so that the bracket can slide transversely, and remove the nut and bolt securing the column clip to the bracket.

Check that the rack is still in the centre of its travel. Push down the column assembly, engage the marked spline of the pinion shaft with the split portion of the inner column clamp, ensuring the clamp bolt can easily be inserted. Tighten the clamp bolt to a torque of 8 to 9 lb. ft. (1·2 kg. m.).

Swing the steering-column upwards until the bolt securing the column clamp to the column bracket can be inserted and rotate the outer column until the arm of the flasher switch is pointing outwards and upwards at an angle of 8° above the central horizontal line of the column.

Tighten the 'U' bolt nuts, the column support bracket screws, and the bolt securing the column clamp to the support bracket.

The remainder of the assembling is in the reverse order to that of dismantling.

SECTION KK

THE FRONT SUSPENSION

The information given in this Section refers specifically to the Mini-Cooper and must be used in conjunction with Section K

	Section
Front swivel hubs	KK.1
Lubrication	KK.2

Section KK.1

FRONT SWIVEL HUBS

Removing

Raise the front of the vehicle and remove the road wheel.

Knock back the lock washer and disconnect the tie-rod ball end from the steering lever and the drive shaft from the flexible coupling, leaving the 'U' bolts securing the coupling to the differential flange in position.

Separate the two halves of the dust cover, unscrew the two bolts retaining the disc brake calliper assembly to the hub, detach the dust cover halves, and remove the assembly, placing it on a support to prevent strain on the hydraulic hose.

Detach the nuts and spring washers retaining the top and bottom ball pins and release the upper and lower suspension arms from the pins. Withdraw the swivel hub assembly complete with the drive shaft. Remove the split pin and unscrew the slotted nut and spacing washers from the end of the drive shaft.

Detach the swivel hub from the drive shaft, using Service tool 18G 304 with adaptor bolts 18G 304 F.

Remove the driving flange and disc assembly from the hub, using Service tool 18G 575.

Remove the four countersunk Phillips screws from the flange of the hub and detach the brake disc assembly. Remove the spacer from the outer face of the hub, noting that the chamfered face of the spacer is towards the hub driving flange. Extract the inner and outer grease seals, together with the spacing ring between the inner grease seal and the inner bearing. Remove the hub bearings from their respective sides of the hub bore, using Service tool 18G 260 with adaptor 18G 260 H.

Reassembly is a reversal of the dismantling procedure. The bearings only are to be packed with grease on reassembly.

Should the tie-rod ball end lock washer be damaged in any way, **it must be renewed.**

Section KK.2

LUBRICATION

Lubricating nipples are located on each swivel hub (see Fig. KK.1). Jack up the front of the car to take the load off the swivel hub ball pin assemblies. Clean the lubricating nipples and apply a grease gun filled with grease to Ref. C (End of Manual). If the ball pin assemblies are already filled with grease no further grease can usually be forced in.

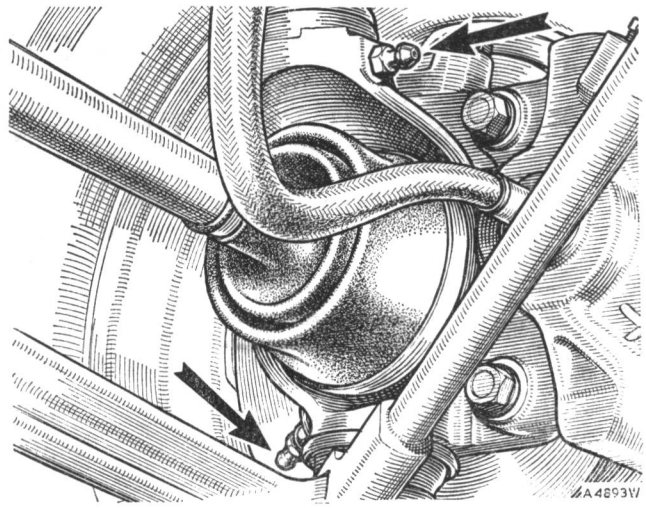


Fig. KK.1

The swivel hub lubricating nipples

SECTION KKK

THE FRONT SUSPENSION

The information given in this Section refers specifically to the Mini-Cooper 'S' and must be used in conjunction with Sections K and KK

Section

Front hubs KKK.1

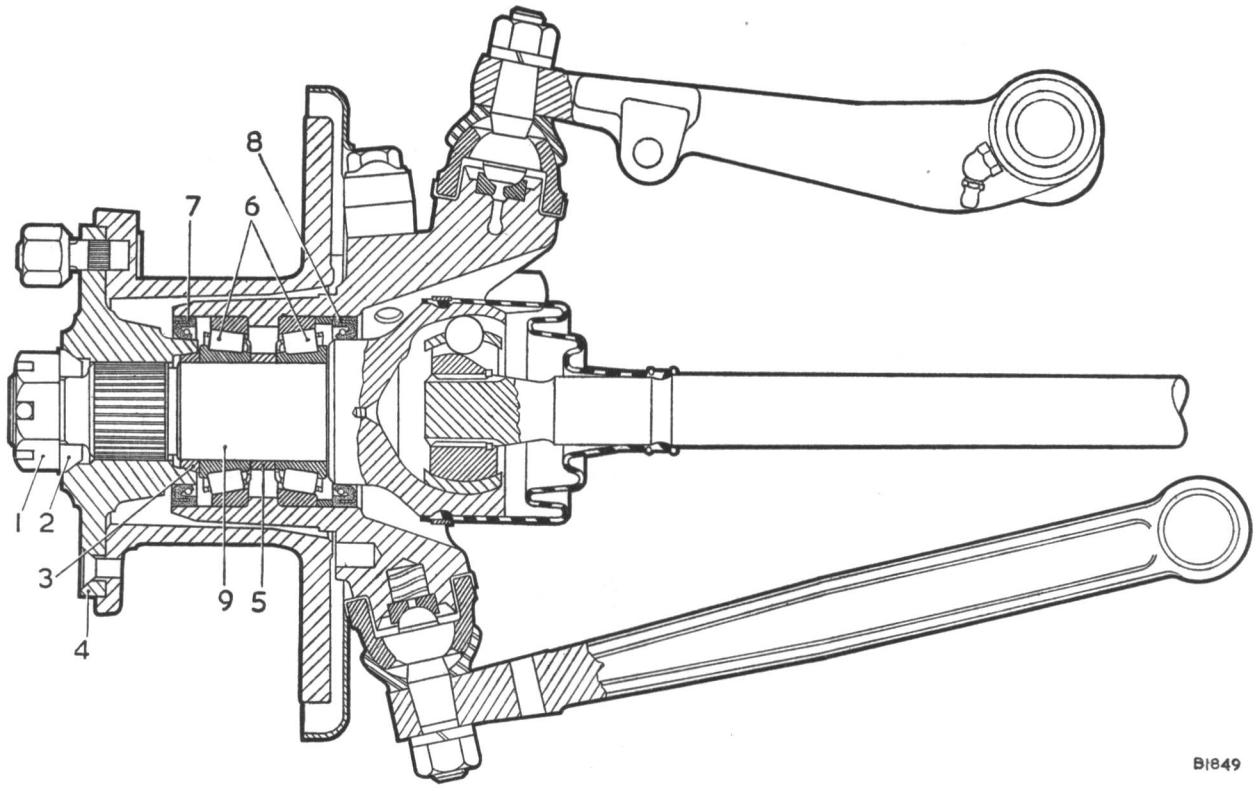


Fig. KKK.1

The front hub assembly

1. Drive shaft nut.
2. Outer tapered collar.
3. Inner tapered collar (early models only).
4. Hub and disc assembly.
5. Bearing distance piece.
6. Taper-roller bearings.
7. Outer oil seal.
8. Inner oil seal.
9. Drive shaft.

Section KKK.1

DISMANTLING FRONT HUBS

When fitting new front hub bearings it is essential to replace the old distance piece with the new one supplied in the replacement bearing pack (Part No. 21A 1400). The new bearings comprise a matched set and must be used as such, otherwise the bearings will be out of adjustment when the hub is fully assembled.

Remove the split pin and unscrew the drive shaft nut. Lightly tap the end of the shaft with a hide hammer and pull off the driving flange and brake disc assembly, together with the outer split taper collar. Extract the drive shaft from the rear of the hub and remove the distance piece and inner and outer bearings.

Remove the two oil seals from the hub, extract the inner and outer bearing caps, using a brass drift (with a suitably angled face), and, making use of the two recesses in the shoulder in the hub, drive out one of the bearing cups. Take care not to damage the shoulder or bore of the hub during this operation. Drive out the other bearing cup, using a suitable drift to maintain the cup at right angles to the bore of the hub.

Reassembling

Before fitting the new bearings ensure that the hub bore and shoulder are perfectly clean and undamaged: any burrs or screw marks on these parts may cause the bearing cups to seat incorrectly and thus upset the bearing adjustment. Carefully remove any such high-spots with the aid of a scraper.

Position the bearing cups in the hub, using a suitable drift. Ensure that both cups are hard against the shoulder in the hub. Insert the inner bearing (packed with grease) into the rear of the hub and fit the oil seal.

Mount the hub onto the drive shaft and fit the distance piece, outer bearing (packed with grease), and oil seal, to the hub.

Fit the inner split taper collar (early models only), driving flange and brake disc assembly, outer split taper collar, and secure with the drive shaft nut. Tighten the nut to a torque reading of 150 lb. ft. (20·739 kg. m.) and check for run-out at the periphery of the disc. If the run-out exceeds ·006 in. (·15 mm.) the disc and flange assembly must be removed and repositioned on the drive shaft splines.

When the run-out is within the required limits, insert a new split pin and lock the nut to the shaft. If necessary, tighten the nut to align the next split-pin hole.

SECTION MM

THE BRAKING SYSTEM

The information given in this Section refers specifically to the Mini-Cooper and must be used in conjunction with Section M

	Section
Brake-bleeding	MM.3
Brake disc regrinding	MM.5
Brake intensifier cylinder	MM.2
Front disc brakes	MM.1
Modified callipers	MM.4

Section MM.1

FRONT DISC BRAKES

Description

The front brakes are of the rotating disc and rigidly mounted calliper type, each calliper containing two friction pad assemblies between which the disc rotates. The friction pads are applied to the disc by means of two pistons operated by hydraulic pressure and are automatically retracted when the hydraulic pressure is released. Wear on the friction pads is taken up automatically and no adjustment is necessary.

When the friction pads require renewal they are readily detachable without removing the calliper from its mounting.

Anti-squeak shims are fitted between each piston face and the friction pad on later cars.

Operation

Fluid pressure generated in the master cylinder by the application of the brake pedal enters the mounting half of the calliper and passes through internal fluid passages to the rim half, thus exerting equal pressure on both operating pistons simultaneously and bringing the friction pads into contact with the disc faces.

The pistons are sealed to prevent moisture and dirt from entering by means of a rubber seal fitted to the mouth of the bore of each half of the calliper, and are also sealed to prevent fluid leakage by a rubber seal fitted in a groove in each calliper bore.

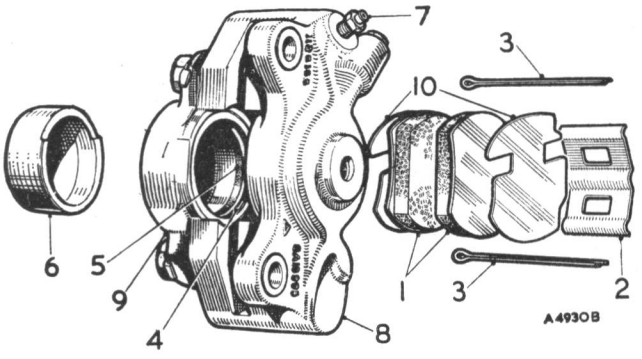


Fig. MM.1

The calliper components

1. Friction pads.
2. Pad retaining spring.
3. Retaining split pins.
4. Piston dust seal.
5. Piston fluid seal.
6. Piston, showing cut-away at top.
7. Bleeder screw.
8. Mounting half calliper.
9. Rim half calliper.
10. Anti-squeak shim.

The fluid seals grip the outer diameter of the pistons tightly, and outward movement of the pistons causes each seal to extrude into the bore of the calliper.

When fluid pressure is released from the piston the seals return to their original positions, causing the pistons to retract, thus creating a running clearance between the friction pads and the disc.

As the friction pads wear with use, the pistons move progressively outwards to compensate for this, thus eliminating the necessity for manual adjustment.

Renewing friction pads

Jack up the car and remove the road wheel. Depress the pad retaining spring and withdraw the split pins (see Fig. MM.2). Remove the spring and withdraw the friction pads from the calliper, using a slight rotational movement to assist removal. It may be necessary to use a pair of pointed-nose pliers for this operation.

Remove the anti-squeak shims, thoroughly clean the exposed face of each piston, and ensure that the recesses in the calliper which receive the friction pad assemblies are free from rust and grit. Press each piston back into

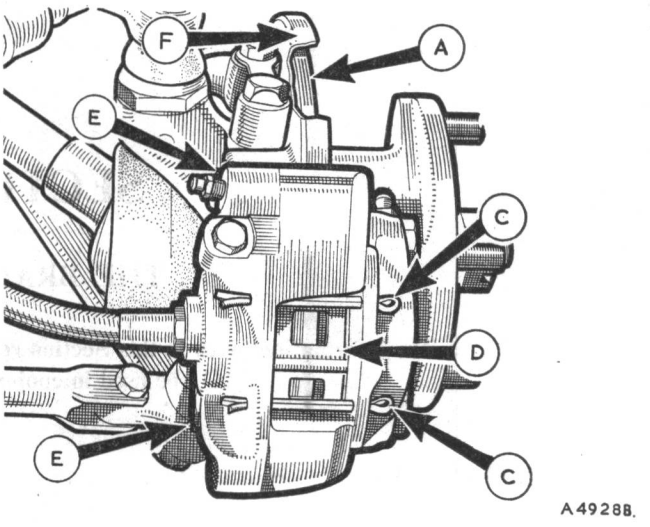


Fig. MM.2

The disc brake assembly

A. Brake disc.
C. Split pins.
D. Pad retaining spring.
E. Calliper mounting bolts.
F. Dust cover.

the calliper, using Service tool 18G 672. Whilst this is being done the fluid level in the master cylinder will rise, due to fluid being displaced by the pistons. It may be necessary to siphon off any surplus from the master cylinder to prevent the fluid from overflowing.

Check that the cut-away edge of each piston is facing upwards and that the anti-squeak shims are correctly fitted (see Fig. MM.1) and fit the new friction pad assemblies into the calliper.

Ensure that the pad assemblies are free to move easily in the calliper recesses. Remove any high-spots from the pad pressure plate by filing carefully.

Refit the retaining spring in position, press down the spring, and insert the split pins. If the retaining springs show any signs of damage or loss of tension, new springs must be fitted.

After fitting new friction pads operate the brake pedal several times to adjust the brake. Top up the master cylinder if necessary.

Removing and dismantling a calliper

Knock back the locking tabs and slacken the nut securing the tie-rod ball end to the steering-arm. Unscrew and remove the two screws and nuts retaining the locking plate to the disc brake dust cover. Slacken and remove the two bolts securing the calliper to the front hub, detach

the upper and lower halves of the dust cover, and remove the calliper assembly. Do not remove the rubber hose, and support the calliper to avoid straining the hose. Remove the friction pads and clean the outside of the calliper, making sure that all dirt and traces of cleaning fluid are completely removed.

Clamp the piston in the mounting half of the calliper and gently apply the foot brake. This operation will force the piston in the rim half of the calliper to move outwards. Continue with gentle pressure on the foot pedal until the piston has emerged sufficiently for it to be removed by hand. Have a clean receptacle ready to catch the fluid as the piston is removed.

With a suitable blunt-nosed tool remove the fluid seal from its groove in the bore of the calliper, taking great care not to damage the bore of the calliper or the seal retaining groove.

The dust seal retainer can be removed by inserting a screwdriver between the retainer and the seal and gently prising the retainer from the mouth of the calliper bore. The rubber seal can then be detached.

Remove the clamp from the mounting-half piston. To remove the mounting-half piston from the calliper it is necessary first to refit the rim-half piston, and thereafter the procedure is as previously detailed.

When cleaning out the calliper it is essential that only methylated spirit or Lockheed Brake Fluid be used as a cleaning medium. Other types of cleaning fluid may damage the internal rubber seals between the two halves of the calliper.

Reassembling

Coat a new fluid seal with Lockheed Disc Brake Lubricant, making sure that the seal is absolutely dry before so doing, and ease the seal into its groove with the fingers until it is seating correctly in the groove.

Slacken the bleeder screw in the calliper one complete turn. Coat the piston with Lockheed Disc Brake Lubricant and locate the piston squarely in the mouth of the bore with the cutaway portion of the piston face facing upwards (see Fig. MM.1).

Press in the piston, using Service tool 18G 672, until approximately $\frac{5}{16}$ in. (7·94 mm.) of the piston is protruding from the bore. Take great care to prevent the piston tilting during this operation. If the dust seal and retainer have been previously removed, take a new, perfectly dry dust seal, coat it with Lockheed Disc Brake Lubricant, and fit the seal into its retainer. Position the seal assembly on the protruding portion of the piston with the seal innermost, ensuring that the assembly is square with the piston. Press home the piston and seal assembly with the clamp. Retighten the bleeder screw.

The mounting-half piston is dealt with in the same manner as described for the rim-half piston. The rubber hose must be disconnected to allow the clamp to be used and the bleeder screw must be slackened.

Reconnect the hose and refit the calliper and the two halves of the dust cover to the hub.

Refit and tighten the two screws retaining the dust cover to the tie-rod end nut locking plate. Tighten the tie-rod ball end nut to the correct torque tightness and

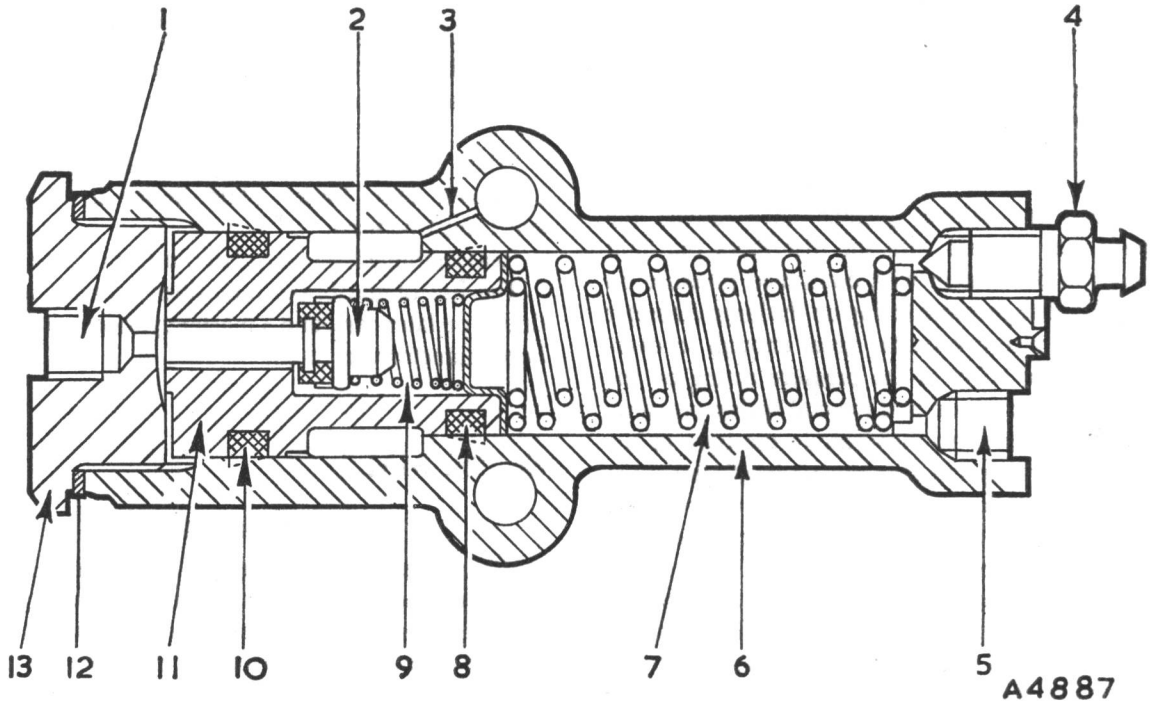


Fig. MM.3

The brake cylinder intensifier

1. Fluid inlet.
2. Valve.
3. Air relief passage.
4. Bleed screw.
5. Fluid outlet.
6. Intensifier cylinder body.
7. Piston return springs.
8. Piston seal (small).
9. Valve return spring.
10. Piston seal (large).
11. Piston.
12. Copper gasket.
13. Hexagon end plug.

knock up the locking tabs on **both** sides of the nut. **Should the locking plate be damaged in any way, it must be renewed.**

Tighten the calliper mounting bolts to the correct torque tightness (see **'GENERAL DATA'**).

Do not depress the brake pedal. Fit the friction pad assemblies, together with their retaining springs and split pins, and bleed the system.

After bleeding operate the brake pedal several times to adjust the brake.

Section MM.2

BRAKE INTENSIFIER CYLINDER

To increase the hydraulic pressure available for the front brakes without a corresponding increase in the required pedal effort a brake intensifier is incorporated in the system. The intensifier cylinder is mounted on the right-hand wing valance in the engine compartment, and is connected to the fluid line from the master cylinder at its lower end and to the fluid line for the front disc brakes at the top connection.

Operation

The intensifier has a two-diameter bore in which a stepped piston is fitted. The piston has a rubber seal around both its large and small diameters and is held in the 'off' position by two coil springs. The centre portion of the piston is machined to accept a valve and spring. The valve is held open against the spring by its stem abutting against the body of the intensifier when the piston is in its 'off' position.

When the brake pedal is first applied fluid from the master cylinder passes through the centre of the piston around the valve into the smaller diameter of the intensifier bore, and out along the fluid line to the brake callipers. When the calliper pistons have moved the friction pads into contact with the disc faces the fluid pressure rises in the system with continued pressure on the brake pedal. The pressure acting on the large diameter of the intensifier piston becomes great enough to overcome the combined effect of the pressure acting on the small diameter of the piston and the coil spring pressure, thus allowing the piston to move along the bore of the intensifier. The valve spring then asserts itself, closes the valve, and prevents fluid passing through the centre of the piston. The fluid in the two diameters of the cylinder bore is then positively separated. As the brake pedal is depressed farther, the hydraulic pressure on the large face of the piston increases and forces the piston farther along the bore. This creates an even greater pressure in the fluid contained in the smaller diameter of the intensifier cylinder bore, i.e. as the face of the piston is smaller, the pressure will be greater since the same amount of force as that acting on the large face of the piston is being exerted over a smaller area. Thus a greater pressure is available at the callipers to apply the brake than would be the case if no intensifier cylinder were fitted, without any corresponding increase in the total effort required at the brake pedal. When the brake pedal is released the intensifier piston is returned to its 'off' position, ready for the cycle of operations to be repeated when the brake pedal is again depressed.

The area between the seals of the two diameters of the piston forms an air gap, and to allow for changes in volume of this area an air passage is fed into one of the mounting holes in the body of the intensifier casting.

It is important that fixing bolts of the correct diameter be used so that a clearance exists between the bolt and the diameter of the hole to allow the passage of air. The flange of this bolt hole is also machined at one end to allow air flow, and must not be filed flat or obstructed.

Removing

Slacken the top pipe union, from under the wheel arch remove the two nuts and spring washers, and withdraw the two intensifier mounting bolts. Completely unscrew the top union and withdraw the pipe and union.

Rag should be laid beneath the intensifier to catch any fluid.

Lift up the intensifier, unscrew the bottom pipe union, and withdraw the union and pipe. The intensifier can then be completely removed.

Dismantling

Grip the body of the intensifier across the flat surfaces of the mounting lugs in a vice, using soft jaws, and unscrew the large hexagon plug carefully. The plug also acts as a stop for the internal springs and is under spring pressure.

Extract the piston assembly and coil springs.

Examine the rubber seals, and if any damage or deterioration is apparent the piston assembly must be renewed as a whole.

When cleaning the internals of the intensifier only Lockheed Disc Brake Fluid Series 2 or methylated spirit must be used.

Reassembling is a reversal of the dismantling procedure.

The use of the brake intensifier cylinder was discontinued on later cars, and a master cylinder with a modified bore diameter was fitted.

Section MM.3

BRAKE-BLEEDING

When bleeding the system the brakes must be correctly adjusted (rear only), and before proceeding with the bleeding operation as described in Section M.4 the bleeder screw at the top of the intensifier (when fitted) must be slackened and the brake pedal operated until air-free fluid issues. Tighten the bleed screw, top up the master cylinder, and proceed to bleed the brakes in the normal way.

The front wheels must be removed to gain access to the bleed screws on the front brakes on early models.

Use Lockheed Disc Brake Fluid Series 2 only.

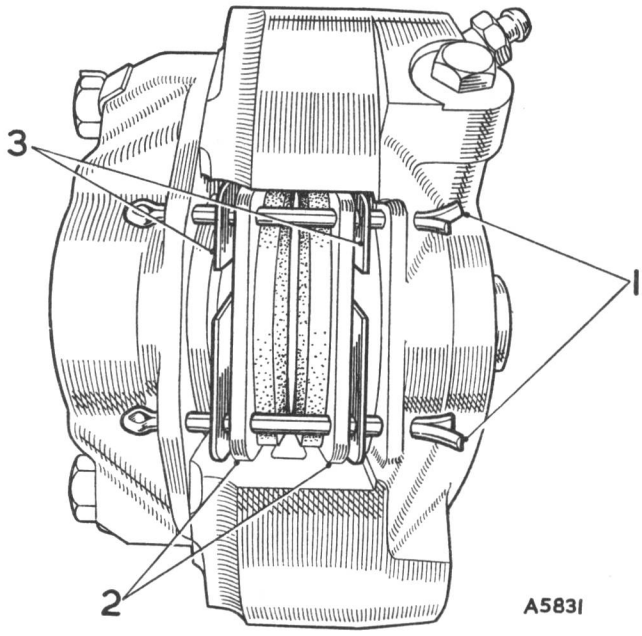


Fig. MM.4

The modified calliper assembly

1. Pad-retaining split pins. 2. Brake pads.
3. Anti-squeak shims.

Section MM.4

MODIFIED CALLIPERS

From Car Nos. CA2S4 382852, KA2S4 382183 R.H.D., CA2S4 383843, and KA2S4 379926 L.H.D. a modified type of calliper was fitted. The later-type calliper is similar in operation and construction to the earlier type described in Section MM.1, and varies only in that the pads are different in shape and method of retention in the calliper. The two split pins pass through the calliper body and also through the pad pressure plates (see Fig. MM.4). No pad-retaining springs are fitted.

To remove the pads after jacking up and removing the road wheel it is only necessary to withdraw the split pins and extract the pads from the calliper with a direct pull.

NOTE.—The pads for the two types of calliper are NOT interchangeable, and pads from one type of calliper must not be fitted to the other type.

Section MM.5

BRAKE DISC REGRINDING

Should the front brake discs be badly scored, the surfaces may be reground to the dimensions given in Fig. MM.5, These limits must be strictly adhered to. After grinding, the faces (X) and (Y) (Fig. NN.5) must be parallel to each other within ·001 in. (·025 mm.), and the surface finish must not exceed 63 micro-inches. Wobble between the faces (Y) and (Z) (Fig. MM.5) must not exceed a total of ·002 in. (·05 mm.).

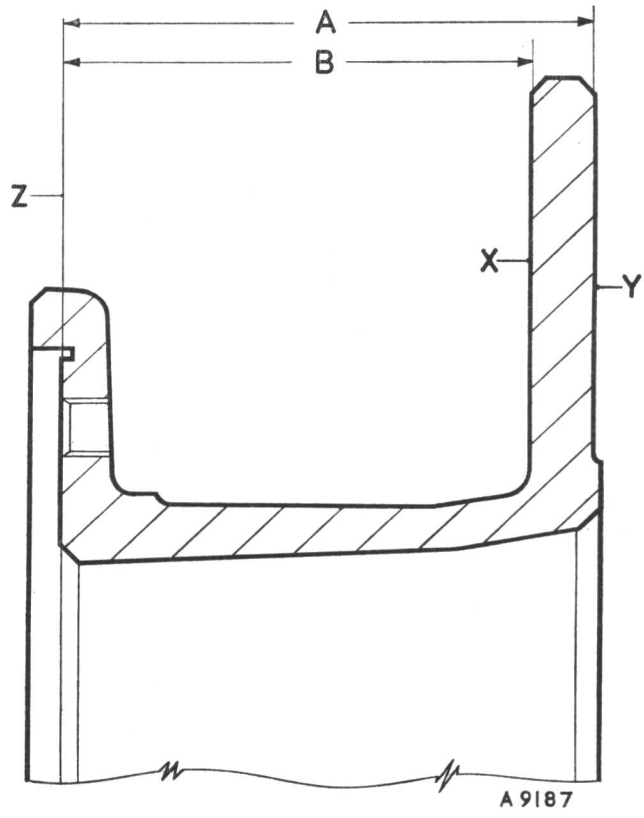


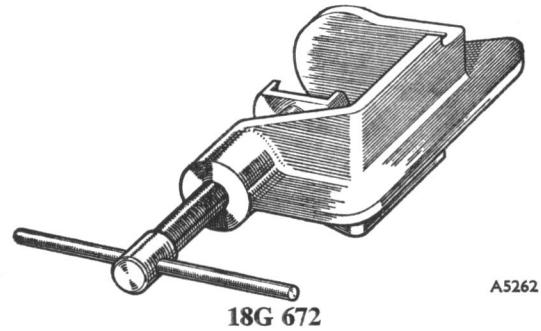
Fig. MM.5

Dimension (A) *must not be less than* 2·292 *in.* (58·21 *mm.*) *after grinding. Dimension* (B) *must not be greater than* 2·078 *in.* (52·78 *mm.*) *after grinding*

SERVICE TOOLS

18G 672. Disc Brake Piston Seal Replacer

To enable the piston to be set to zero when fitting replacement pads and also to refit the piston and dust seal after dismantling.



18G 672

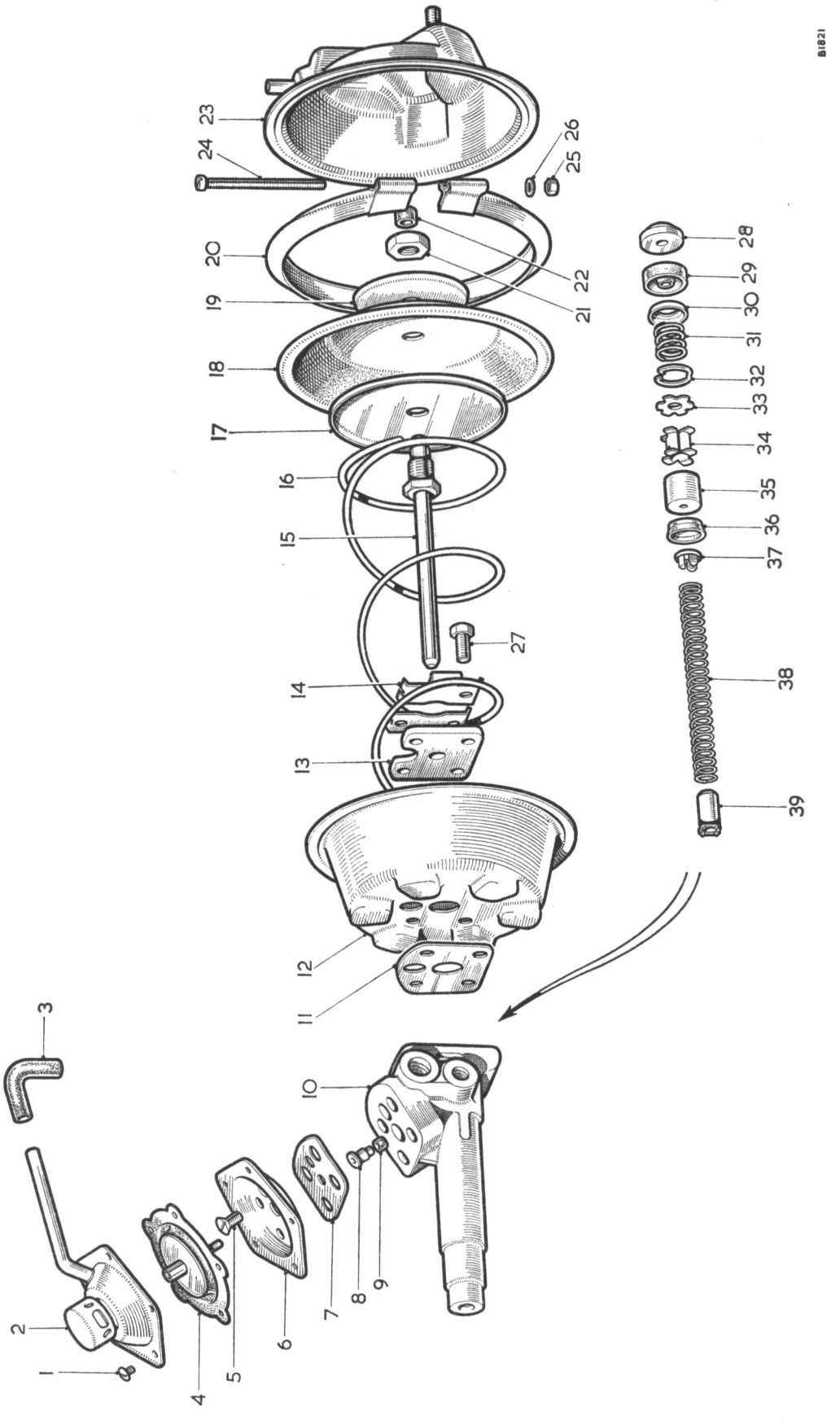
SECTION MMM

THE BRAKING SYSTEM

The information given in this Section refers specifically to the Mini-Cooper 'S' and must be used in conjunction with Sections M and MM

	Section
Air filter	MMM.4
Vacuum servo unit	MMM.1
Dismantling and reassembling	MMM.3
Removing and replacing	MMM.2

THE VACUUM SERVO COMPONENTS



KEY TO THE VACUUM SERVO COMPONENTS

No.	*Description*
1.	Screw for air valve cover.
2.	Air valve cover.
3.	Rubber elbow.
4.	Control valve diaphragm.
5.	Screw for valve housing.
6.	Valve housing.
7.	Housing gasket.
8.	Valve piston.
9.	Rubber cup for piston.
10.	Slave cylinder body.
11.	Gasket—slave cylinder to vacuum shell.
12.	Vacuum shell.
13.	Abutment plate.
14.	Locking plates.
15.	Push-rod.
16.	Return spring.
17.	Plate (large) for diaphragm.
18.	Diaphragm.
19.	Plate (small) for diaphragm.
20.	Clamping ring.
21.	Nut for diaphragm assembly.
22.	Rubber buffer.
23.	End cover.
24.	Clamping bolt.
25.	Nut for clamping bolt.
26.	Washer for nut.
27.	Screw—vacuum shell to slave cylinder.
28.	Guide piece.
29.	Push-rod cup.
30.	Cup spreader.
31.	Spring.
32.	Circlip.
33.	Washer.
34.	Distance piece.
35.	Piston.
36.	Cup.
37.	Spring guide.
38.	Spring.
39.	Spring retainer.

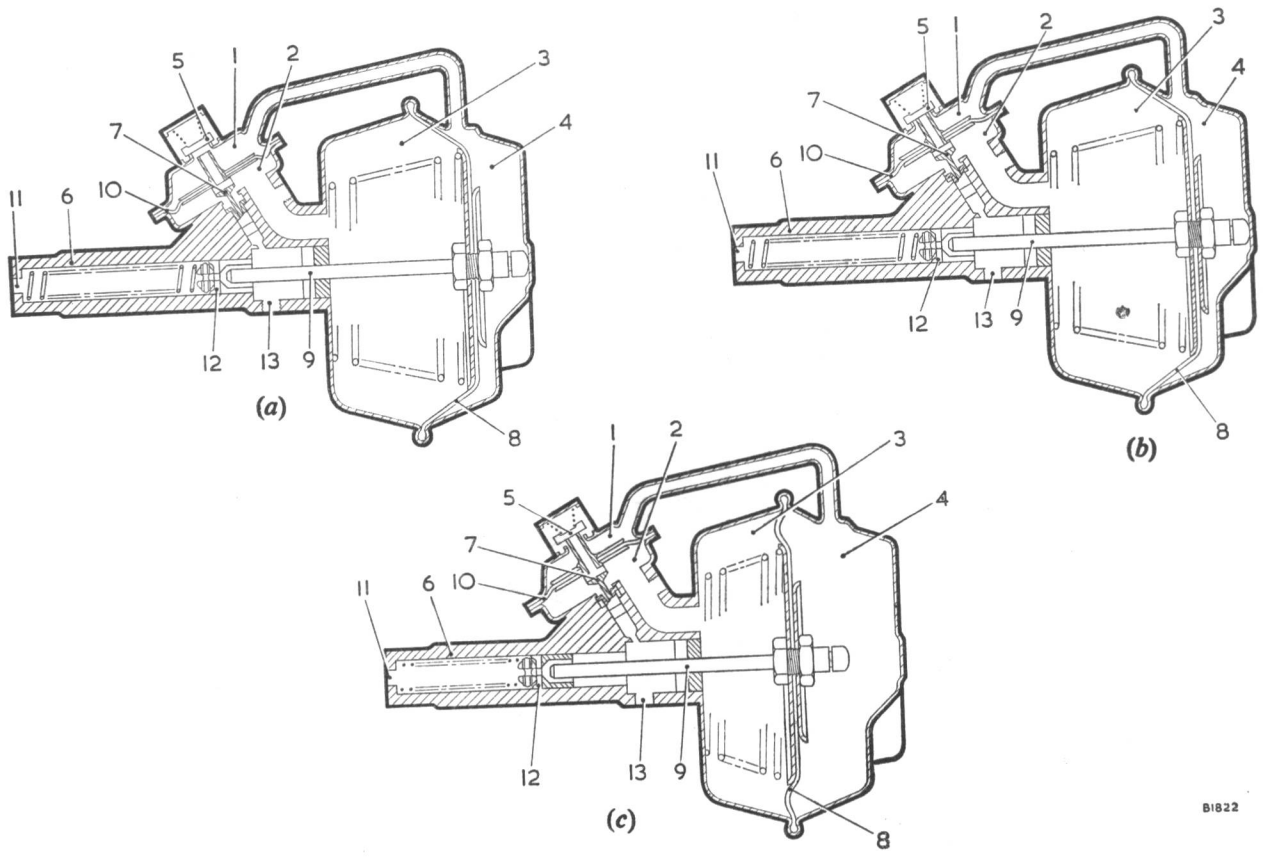


Fig. MMM.1

The operation of the vacuum servo

1. Chamber 'A'.
2. Chamber 'B'.
3. Chamber 'C'.
4. Chamber 'D'.
5. Air valve.
6. Slave cylinder.
7. Valve piston.
8. Booster diaphragm.
9. Push-rod.
10. Diaphragm.
11. Fluid outlet to brakes.
12. Cup.
13. Fluid inlet from master cylinder.

Section MMM.1

VACUUM SERVO UNIT

Description

The vacuum servo unit, which provides a degree of assistance when the brakes are applied, comprises a control valve, a booster diaphragm, a slave cylinder, and a non-return valve. The power for its operation is provided by atmospheric pressure and by vacuum from the engine inlet manifold.

Operation

The following paragraphs explain the operation of the vacuum servo unit, and should be studied in conjunction with the illustration in Fig. MMM.1.

When the brakes are 'off' the servo is at rest (see [*a*], Fig. MMM.1). With the unit in this condition, whatever degree of vacuum is present at the vacuum connection is also present within chambers 'B' and 'C' of the servo; additionally the vacuum is transferred to chamber 'A', via the hollow stem of the control valve diaphragm, and to chamber 'D' via the connecting pipe. The air valve is maintained in the closed position illustrated due to the pressure differential across it and the influence of the spring.

When the brake pedal is depressed, initial fluid pressure from the master cylinder passes through the slave cylinder to the wheel cylinders; meanwhile, this pressure is also felt upon the rear face of the valve piston which displaces the diaphragm until the stem contacts the air valve. Chambers 'A' and 'D' are then isolated from the vacuum source (see [*b*], Fig. MMM.1).

Continued effort on the brake pedal causes the diaphragm stem to lift the air valve, which admits atmospheric pressure to chambers 'A' and 'D' (see [*c*], Fig. MMM.1) and partially destroys the vacuum within these chambers. The result of this is that a pressure differential is created across the booster diaphragm, which overcomes the spring loading and causes the booster diaphragm to deflect, resulting in the push-rod moving nearer to the cup and sealing off the hole in its centre. There is now a locked 'line' of fluid to the wheel cylinders, and the continued influence of the pressure differential across the booster diaphragm adds to the master cylinder pressure acting on the booster cylinder piston and increases the pressure within the booster cylinder and the brake line.

The same pressure differential also exists across the control valve diaphragm but it is, of course, opposed by the master cylinder pressure acting on the valve piston. When the desired degree of braking has been reached

these forces balance; the control valve diaphragm has by then deflected back to the position shown in (*b*), Fig. MMM.1, and the air valve closes onto its seat to prevent the further entry of air. The position of the booster diaphragm will be undisturbed and the boost preserved.

It should be appreciated that although this description may suggest a delay whilst these actions are occurring, they actually happen simultaneously with the description of the brake pedal.

Greater effort upon the brake pedal increases the thrust on the valve piston, which causes the air valve to re-open and admit more air, so increasing the pressure differential across the booster diaphragm and allowing it to exert a greater amount of effort. When the opposing forces on the control valve diaphragm are once more in balance, the air valve will again close onto its seat. It will be apparent, therefore, that the control valve diaphragm acts as a proportioning device, ensuring that the performance of the servo is progressive when applying and releasing the brakes.

When the brake pedal is released, pressure is removed from the valve piston, and the action of the control valve diaphragm resuming its natural shape is sufficient to return the piston to the position shown in (*a*), Fig. MMM.1, consequently the air valve resumes its seat.

All four chambers of the servo are now once more in communication with the vacuum source, and the return spring is able to thrust the booster diaphragm to the fully 'off' position. The rearward travel of the slave cylinder piston is, however, arrested by a distance piece before the push-rod reaches the limit of its stroke (this distance piece is omitted from the illustrations in Fig. MMM.1 for clarity, but it is shown on page MMM.2), hence a gap exists between the piston and the push-rod when the booster piston has fully returned.

The fluid in the brake line, which is under pressure from the brake-shoe pull-off springs, is now able to return to the master cylinder, so releasing the brakes.

Section MMM.2

REMOVING AND REPLACING THE VACUUM SERVO UNIT

Disconnect the forward end of the heater hose from the grille; release the clip holding it to the slave cylinder and secure the hose out of the way.

Disconnect the hydraulic pipes from the slave cylinder and plug the open ends of the pipes to prevent the loss of fluid or the entry of dirt.

Release the vacuum rubber pipe from the non-return valve on the slave cylinder.

Remove the two nuts and spring washers securing the servo unit to its rear mounting bracket (one of these nuts secures the clip for the vacuum pipe).

Release the servo unit from the front mounting bracket and remove the unit from the vehicle.

Replacement of the servo unit is a reversal of the removal procedure. Bleed the braking system as described in Section M. It will be necessary to pump the brake pedal to destroy the vacuum and thus preventing the servo from operating during this procedure.

Section MMM.3

DISMANTLING AND REASSEMBLING THE VACUUM SERVO UNIT

Remove the five screws and lift off the air valve cover, at the same time disengaging the pipe from the rubber elbow. Pull the elbow off the pipe in the end cover and remove the control valve diaphragm.

Remove the four screws and lift off the valve housing and the gasket. Expel the valve piston by closing the end connection with the thumb and applying a low air pressure at the smaller connection at the side of the cylinder. Ease the rubber cup off the piston.

Unscrew the clamping bolt from its nut and disengage the bolt from the clamping ring; then remove the end cover and the booster diaphragm assembly, and disengage the return spring from the locking plates inside the vacuum shell.

Hold the push-rod by the hexagon of the centre-piece, taking care not to damage the high surface finish of the rod; ease off the rubber buffer, unscrew the nut and separate the various parts of the diaphragm assembly.

Bend back the ears of the locking plates from the heads of the four bolts, unscrew the bolts and separate the vacuum shell from the slave cylinder.

Extract the guide piece, push-rod cup, cup spreader, and spring from the slave cylinder. Depress the piston against the spring pressure, using a $\frac{5}{16}$ in. (7·94 mm.) diameter brass rod, and extract the circlip with a pair of snipe-nosed pliers. Gradually release the load from the piston and remove the remaining parts from the slave cylinder.

Unscrew the non-return valve from the side of the slave cylinder.

Wash all the components in industrial methylated spirit with the exception of the air valve cover, which should have compressed air (at low pressure) blown past the air valve and into the filter chamber. Dry the components thoroughly, using a lint-free cloth or an air-pressure line.

Examine the metal parts before reassembly and renew any parts showing signs of wear or damage. If the pipe in the vacuum shell cover is loose a new end cover assembly must be used. New rubber seals, cups, and diaphragms should be used throughout. The vacuum non-return valve cannot be overhauled, and if faulty a new assembly must be used.

Hold the slave cylinder body vertically between soft jaws in a vice, avoiding excessive tightening.

Fit the spring retainer at one end of the spring, and the spring guide at the other end. Insert the spring into the slave cylinder bore, with the retainer leading.

Cup assembly sleeve	
Length	1·61 to 1·62 in. (40·89 to 41·15 mm.)
Outer diameter	·746 to ·748 in. (18·95 to 19·00 mm.)
Inner diameter	·625 to ·627 in. (15·87 to 15·92 mm.)

Position the assembly sleeve (to be made to the above dimensions) at the end of the bore, and pass the cup through it (recessed side leading), taking care not to turn or buckle the lip. Follow up with the piston, flat face leading.

Push the pinion down the bore so as to compress the spring, using a $\frac{5}{16}$ in. (7·94 mm.) diameter brass rod. Hold the spring compressed, remove the assembly sleeve and fit the distance piece, washer and circlip. Take care not to score the bore when fitting the circlip and make sure that it fits into its groove correctly. Gradually release the load on the piston until it is contact with the distance piece and then remove the brass rod.

Insert the spring into the bore and locate the concave side of the cup spreader on it. Ease the push-rod cup into position so that the concave side of this part is in contact with the cup spreader. Locate the guide piece in the end of the bore, with the flat side contacting the cup.

Position the gasket on the end face of the slave cylinder body, followed by the vacuum shell (ensuring that it locates with the spigot of the guide piece); fit the abutment plate, the two locking plates, and four bolts to secure the shell to the cylinder. Tighten the bolts to a torque reading of 150 to 170 lb. in. (1·73 to 1·98 kg. m.) and bend the ears of the locking plates up to the heads of the bolts.

Hold the push-rod by the hexagon centre-piece in a vice, with the threaded end uppermost, taking care to avoid damage to the high surface finish of the rod.

Place the large plate on the push-rod with the lipped side downwards. Place the diaphragm with its concave side (allow the diaphragm to assume its natural shape) against the plate. Place the small plate on the push-rod (with its lipped side uppermost), and secure it by fitting and tightening the nut; lock the nut by punching the threads in two opposed places. Ease the rubber buffer onto the end of the push-rod.

Hold the slave cylinder vertically in a vice and engage the small end of the diaphragm spring with the locking plate tabs.

Position the booster diaphragm assembly on the long end of the spring, with the push-rod pointing downwards. Press down on the diaphragm assembly until the push-rod enters the slave cylinder, and hold in this position whilst fitting the end cover. Hold the end cover down, fit the clamping bolt, and roughly align the pipe in the cover with the inclined face of the slave cylinder. Pass the bolt through the ends of the clamping ring and fit the washer and nut, but do not fully tighten at this stage.

Ease the cup into the groove on the valve piston and insert the piston into the recessed bore in the inclined face of the slave cylinder. Position the gasket on the face, followed by the valve housing, and secure with four screws to a torque reading of 110 to 120 lb. in. (1·15 to 1·38 kg. m.).

Position the diaphragm on the valve housing, with the stem passing through the central hole.

Push the rubber elbow onto the end of the pipe in the air valve cover and offer up the cover to the slave cylinder, at the same time engaging the free end of the elbow with the pipe in the end cover. Fit the five screws and tighten them securely.

Finally position the end cover so that the rubber elbow is in correct alignment with the connecting pipe, and tighten the clamping bolt securely.

Section MMM.4

REMOVING AND REFITTING THE AIR FILTER

Detach the air valve cover by removing the five screws, push the air valve located in the centre of the under side of the cover off its seat, and blow compressed air at low pressure into the filter chamber. Do not lubricate the filter or attempt to remove it from the air valve cover. Release the outer end of the heater air intake hose to gain access to the filter unit.

Refitting is the reversal of the removal procedure.

SECTION NN

THE ELECTRICAL SYSTEM

The information given in this Section refers specifically to the Mini-Cooper and must be used in conjunction with Section N

	Section
Panel and warning lights	NN.1
Roof lamp	NN.2

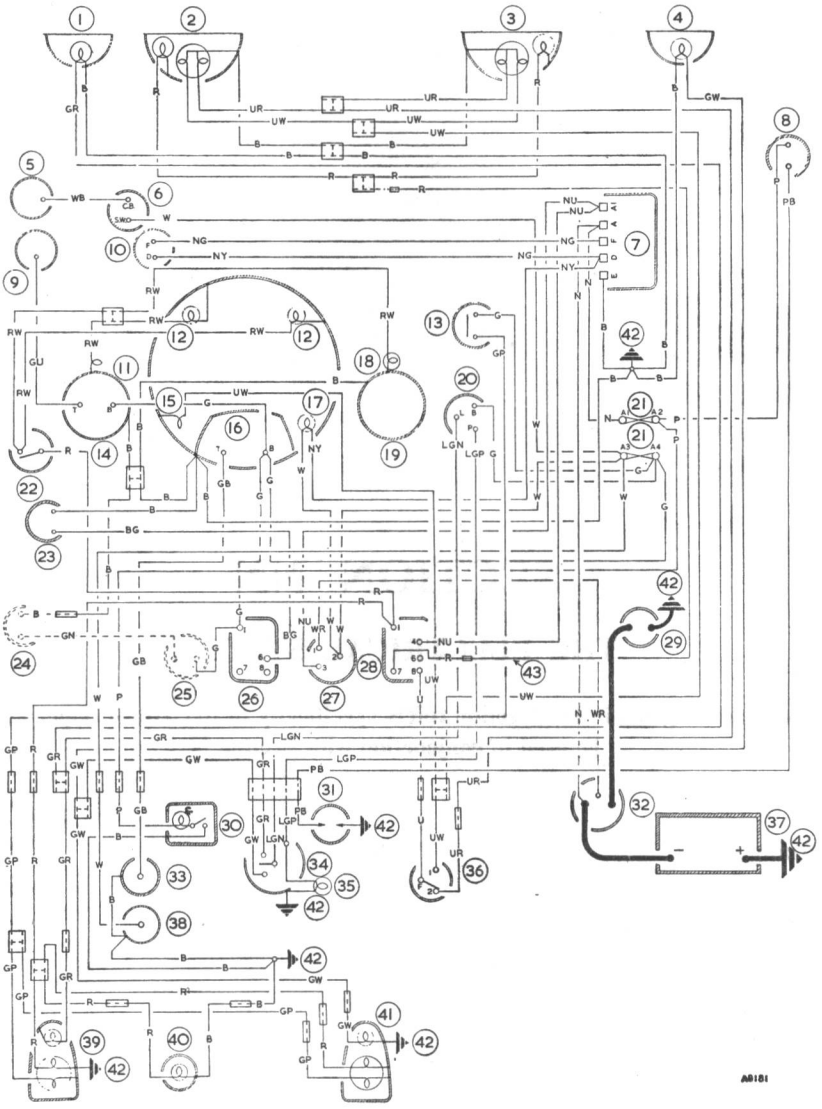


*Fig. NN.*1

Wiring diagram (*Mini-Cooper*) *up to* 1964

1. L.H. flasher lamp.
2. L.H. headlamp and pilot lamp.
3. R.H. headlamp and pilot lamp.
4. R.H. flasher lamp.
5. Distributor.
6. Ignition coil.
7. Voltage regulator and cut-out.
8. Horn.
9. Thermo element.
10. Dynamo.
11. Thermo gauge illumination light.
12. Panel illumination lights.
13. Stop lamp switch.
14. Thermo gauge.
15. Main-beam warning light.
16. Fuel gauge.
17. Ignition warning light.
18. Oil gauge illumination light.
19. Oil gauge.
20. Flasher unit.
21. 35-amp. fuses.
22. Panel lights switch.
23. Wiper motor.
24. Heater motor.
25. Heater switch.
26. Wiper switch.
27. Ignition and starter switch.
28. Lighting switch.
29. Starter motor.
30. Interior lamp.
31. Horn-push.
32. Starter solenoid.
33. Tank unit.
34. Direction indicator switch.
35. Direction indicator warning light.
36. Dipper switch.
37. 12-volt battery.
38. Fuel pump.
39. L.H. stop, tail, and flasher lamp.
40. Number-plate illumination lamp.
41. R.H. stop, tail and flasher lamp.
42. Earth connection.
43. Connect to terminal 6 for North America.

NOTE.—On Export models the pilot lamps are combined with the flasher lamps.

CABLE COLOUR CODE

B. Black.	P. Purple.	Y. Yellow.
U. Blue.	R. Red.	L. Light.
N. Brown.	S. Slate.	D. Dark.
G. Green.	W. White.	M. Medium.

When a cable has two colour code letters the first denotes the main colour and the second denotes the tracer colour.

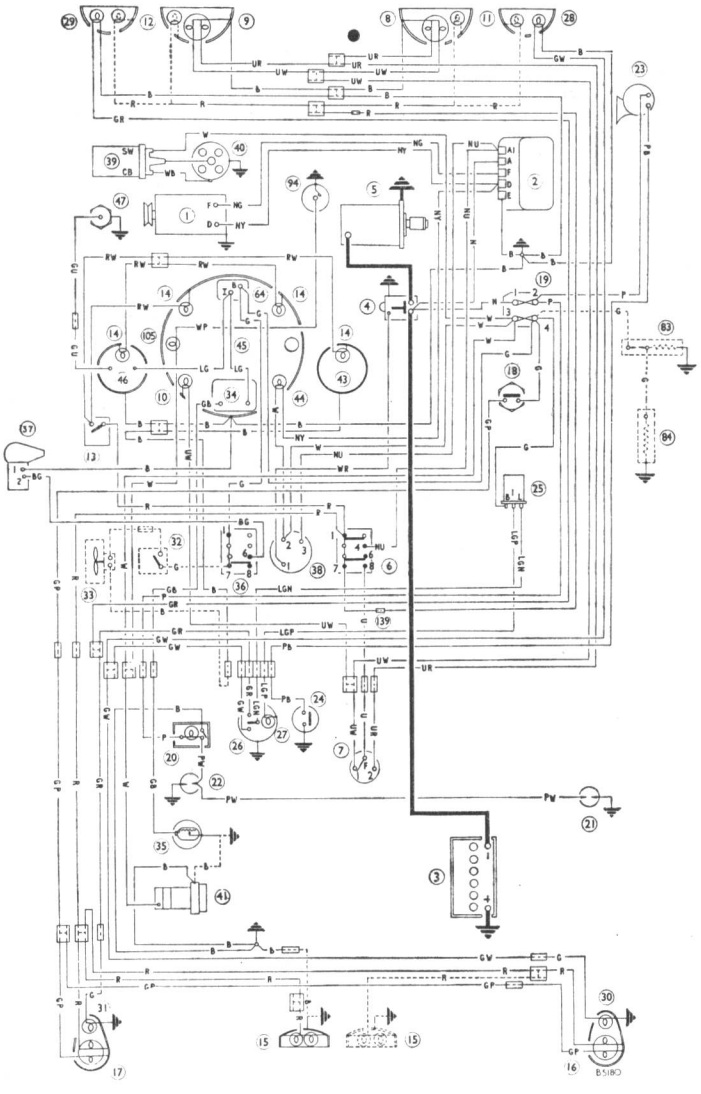


Fig. NN.2

Wiring diagram (Super, Cooper, Cooper Special) 1964 onwards

1. Dynamo.
2. Control box.
3. 12-volt battery.
4. Starter solenoid.
5. Starter motor.
6. Lighting switch.
7. Headlamp dip switch.
8. R.H. headlamp.
9. L.H. headlamp.
10. Main-beam warning lamp.
11. R.H. sidelamp (in headlamp or flasher) lamp.
12. L.H. sidelamp (in headlamp or flasher) lamp.
13. Panel lamps switch.
14. Panel lamps.
15. Number-plate lamp (two for A/M/ADO15/W).
16. R.H. stop and tail lamp.
17. L.H. stop and tail lamp.
18. Stop lamp switch.
19. Fuse unit: 1–2 35 amp., 3–4 35 amp.
20. Interior light.
21. R.H. door switch.
22. L.H. door switch.
23. Horn.
24. Horn-push.
25. Flasher unit.
26. Direction indicator switch.
27. Direction indicator warning lamp.
28. R.H. front flasher lamp.
29. L.H. front flasher lamp.
30. R.H. rear flasher lamp.
31. L.H. rear flasher lamp.
32. Heater switch } when
33. Heater motor } fitted.
34. Fuel gauge.
35. Fuel gauge tank unit.
36. Windshield wiper switch.
37. Windshield wiper motor.
38. Ignition/starter switch.
39. Ignition coil.
40. Distributor.
41. Fuel pump.
42. Oil pressure switch.
43. Oil pressure warning lamp.
44. Ignition warning lamp.
45. Speedometer.
64. Bi-metal instrument voltage stabilizer.
83. Induction heater and thermostat (when fitted).
84. Suction chamber heater (when fitted).
94. Oil filter switch.
105. Oil filter warning lamp.
139. Connect to No. 6 for U.S.A. (alternative connection).

CABLE COLOUR CODE

B. Black.	G. Green.	W. White.
U. Blue.	P. Purple.	Y. Yellow.
N. Brown.	R. Red.	L.G. Light Green.

When a cable has two colour code letters the first denotes the main colour and the second denotes the tracer colour.

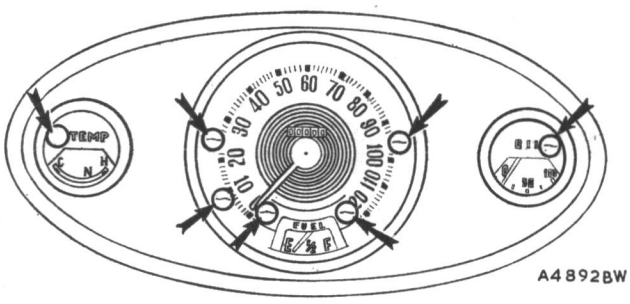


Fig. NN.3

The panel and warning light bulb holders

Section NN.1

PANEL AND WARNING LIGHTS

Access to the warning lights for ignition, headlamp beam, and speedometer illumination bulbs is effected from under the bonnet by withdrawing the push-in-type holders from the rear of the speedometer.

To remove the bulbs from the oil and temperature gauges unscrew the four small Phillips screws visible on the instrument panel inside the car and withdraw the panel cover and shroud to expose the gauges. The bulb holders can then be pulled out from the rear of the gauges.

Section NN.2

ROOF LAMP

Remove the plastic lens of the roof lamp by squeezing the two sides of the lens together until the retaining lugs are clear of their sockets in the base of the lamp, then withdraw the lens. The festoon-type bulb is then readily accessible.

When refitting the lens, fit the retaining lugs into the rear sockets of the lamp base first.

SECTION PP

LUBRICATION

The information given in this Section refers specifically to the Mini-Cooper and must be used in conjunction with Section P

	Section
Carburetter dampers	PP.1
Steering swivel hubs	
Carburetter air cleaners	

NOTE.—The letters given in parentheses throughout the Manual refer to the appropriate section of the recommended lubricants table given on page P.2.

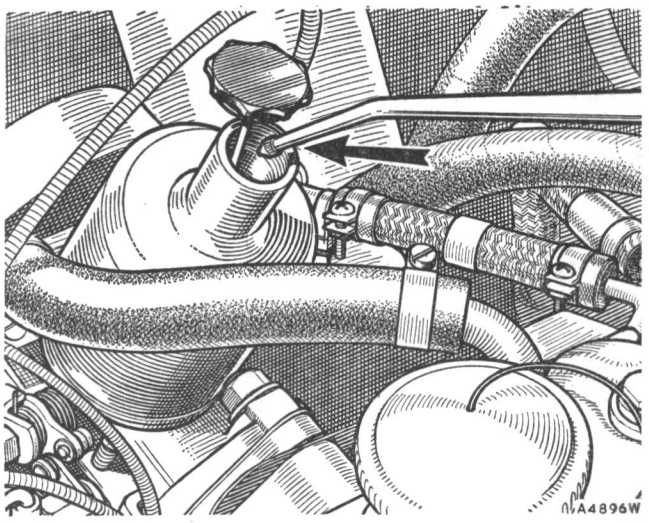


Fig. PP.1

Use thin engine oil to lubricate the carburetter piston dampers. Maintain the oil level to within ½ in (13 mm.) of the top of the hollow piston rods

Section PP.1

CARBURETTER DAMPERS (D)

Unscrew the caps from the tops of the suction chambers, top up with thin engine oil to the correct level, and replace the caps. Under no circumstances should a heavy-bodied lubricant be used. Failure to lubricate the piston dampers will cause the pistons to flutter and reduce acceleration.

Oil to Ref. D (page P.2) should be used.

STEERING SWIVEL HUBS (C)

Lubricating nipples are located as shown in Fig. PP.2 on each swivel hub.

A grease gun filled with grease to Ref. C (page P.2) should be applied to the nipples and given three or four strokes. Jack up the front of the vehicle to take the load off the swivel knuckles and make certain that the lubricating nipples are clean and are not blocked with road dirt. If the knuckles are already filled with grease no further grease can usually be forced in.

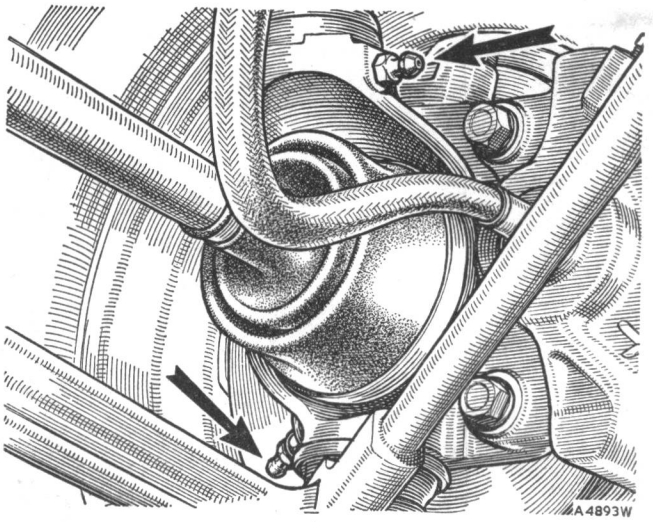


Fig. PP.2

The swivel hub lubricating nipples

CARBURETTER AIR CLEANERS (D)

Remove the cleaners (Fig. PP.3), clean the gauzes thoroughly in fuel, dry, and re-oil with oil to Ref. D.

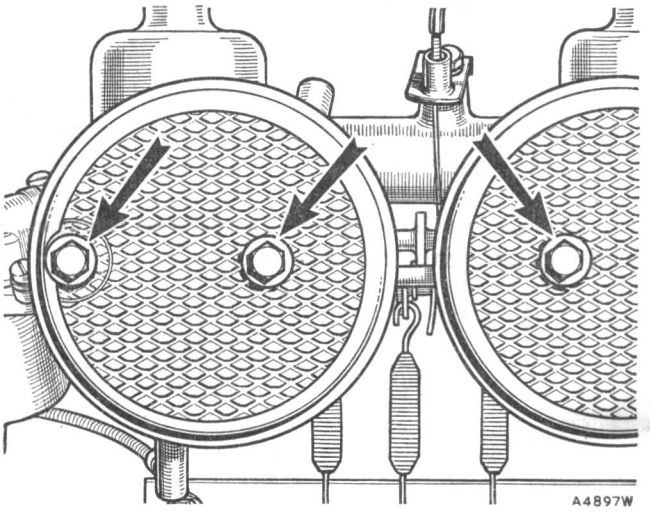


Fig. PP.3

The carburetter air cleaners, indicating three of the four retaining screws

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NOTE.—The periods at which the instructions in this Section should be carried out are contained in the Passport to Service or Driver's Handbook.

SECTION RR

THE BODY

The information given in this Section refers specifically to the Mini-Cooper and must be used in conjunction with Section R

	Section
Heater box removal	RR.4
Instrument panel	RR.1
Rear quarter-light	RR.3
Speedometer	RR.2

Section RR.1

INSTRUMENT PANEL

Removal

Unscrew and remove the four Phillips screws visible on the front face of the instrument panel shroud, withdraw the shroud, and disconnect the wires to the panel lights switch. Disconnect the pipe union from the rear of the oil gauge and disconnect the wires from the back of the temperature gauge.

Remove the four countersunk Phillips screws on the front face of the instrument panel and withdraw the panel complete with oil gauge and temperature gauge.

Release the two knurled nuts retaining each gauge and withdraw the gauges.

Refitting is a reversal of the removal procedure. Ensure when the shroud is being refitted that the panel lights switch is positioned to give a side-to-side action. Should this position of the switch be varied, it could easily result in the switch terminals coming into contact with the oil gauge pipe, thus causing a short-circuit in the electrical system.

Section RR.2

SPEEDOMETER

Removing

Remove the instrument panel (Section RR.1) and unscrew the two screws retaining the instrument panel brackets and speedometer to the speedometer cowling, taking care to retain the distance pieces between the brackets and the cowling. From under the bonnet unscrew the knurled nut retaining the speedometer cable to the instrument and detach the cable. Pull out the four bulb holders from the speedometer and disconnect the cable to the fuel gauge.

Withdraw the speedometer complete with fuel gauge into the engine compartment.

To refit, reverse the removal procedure.

Section RR.3

REAR QUARTER-LIGHT

Removing

Unscrew the two Phillips screws retaining the quarter-light catch to the body and swing the quarter-light open to expose the hinge. Ease back the rubber seal on the body, remove the Phillips screws securing the hinge to the body, and detach the window assembly. The quarter-light frame is secured to the hinge at top and bottom by Phillips screws. When these are removed the frame can be eased away from the glass.

To reassemble and refit the quarter-light reverse the removal procedure.

Section RR.4

HEATER BOX REMOVAL
(Fresh-air Heater)

Drain the radiator, slacken the clip retaining the heater hose to the bottom radiator hose, pull off the heater hose, and allow the heater to drain. If anti-freeze is being used, catch the coolant in a clean receptacle for re-use when refilling the radiator.

From inside the car, detach the instrument surround by removing the four Phillips screws visible on the front face of the surround and detaching the instrument panel switch wires after the surround has been lifted away from the panel.

Disconnect the air intake pipe by slackening its retaining clip and pulling off the pipe from the heater box.

Lift up the parcel shelf trimming to expose the four nuts securing the heater box to the parcel shelf. There are two nuts either side of the instrument panel, one at the front edge of the parcel shelf and one at the extreme rear of the shelf.

Remove the nuts and spring washers, and manœuvre the heater box downwards, taking care not to lose the distance piece fitted to each mounting stud. Lift the box rearwards, detach the demister tubes and the heater hose connections, and remove the heater box.

Replacement is a reversal of the removal procedure.